Lesson №23

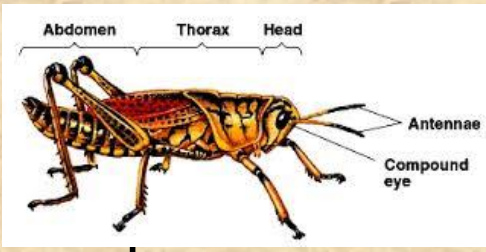
PHYLUM ARTHROPODA, CLASS ARACHNIDA

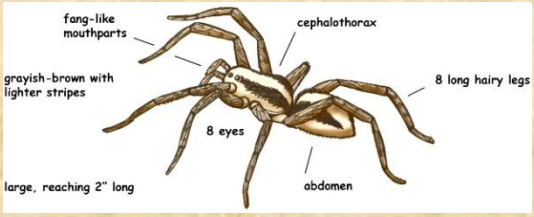
General characteristic and taxonomy of the phylum Arthropoda

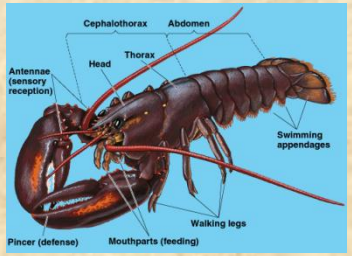
The number of species is over 1.5 million.

Characteristic features:

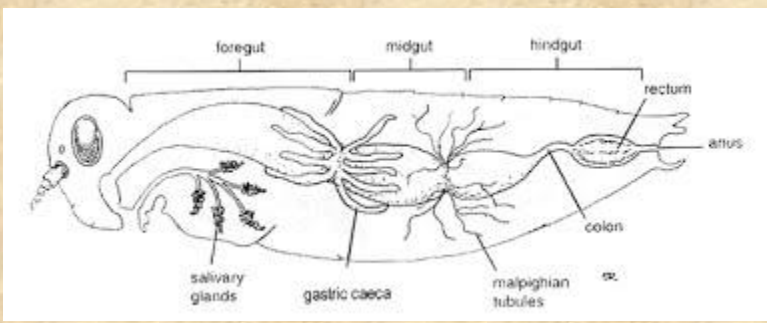
1) development of organ systems from 3 germ layers;
2) bilateral symmetry of the body;
3) heteronomous segmentation;
4) body consists of 2 regions (cephalothorax and abdomen) or 3 regions (head, thorax and abdomen);
5) segmentated extremities;
6) chitinized cuticle (exoskeleton);
7) appearance of striated muscles and separation of muscular groups;
8) mixed body cavity (mixocoel);
9) developed circulatory, respiratory, digestive, excretory, reproductive and nervous systems.

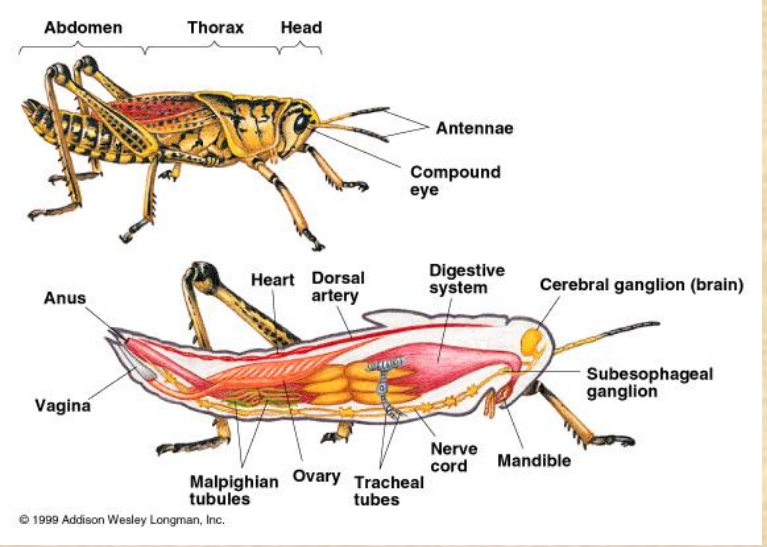


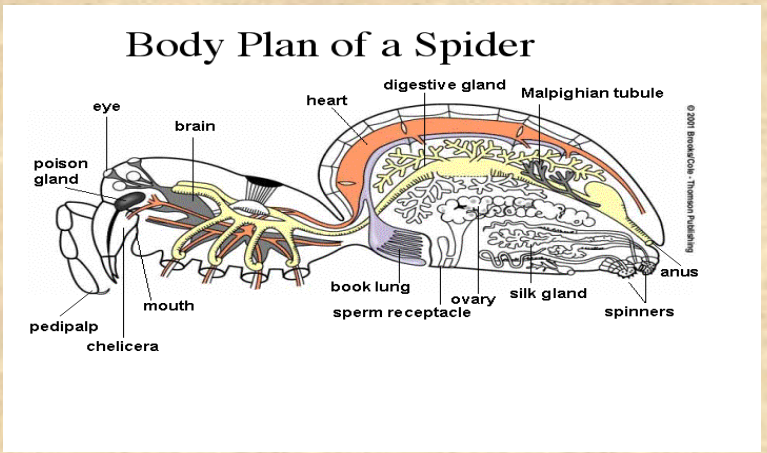




The digestive system consists of 3 regions: foregut, midgut and hindgut. It begins with a mouth opening having mouthparts and ends with an anal opening. There are digestive glands such as salivary glands and liver in the middle region. *Excretory organs* are modified metanephridia (green and coxal glands) or Malpighian tubules. *Respiratory organs* are: gills in aquatic artropods, book lungs and trachea in terrestrial ones.

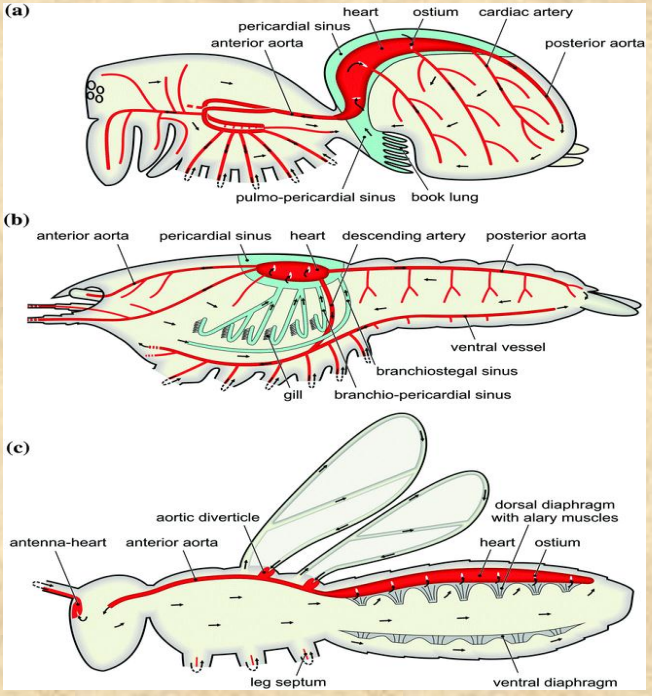


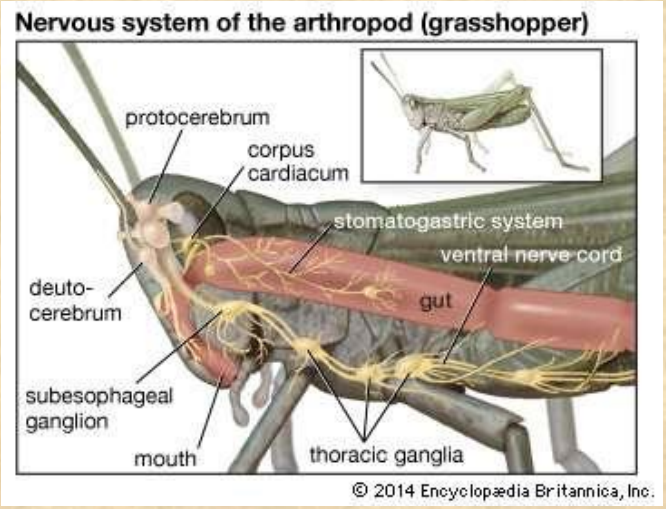




The circulatory system is open. The heart is located on the dorsal side of the body.

The nervous system includes a large cerebral ganglion, performing the function of the brain, a circumpharyngeal nerve ring and ventral nerve chord. There are s*ensory organs* of sight, smell, tactile sense, taste, hearing and equilibrium. Arthropods are dioecious (have separate sexes). Males and females are differed in size and colour, such distinction is sexual dimorphism. Development is direct or indirect (with metamorphosis).





Classes:

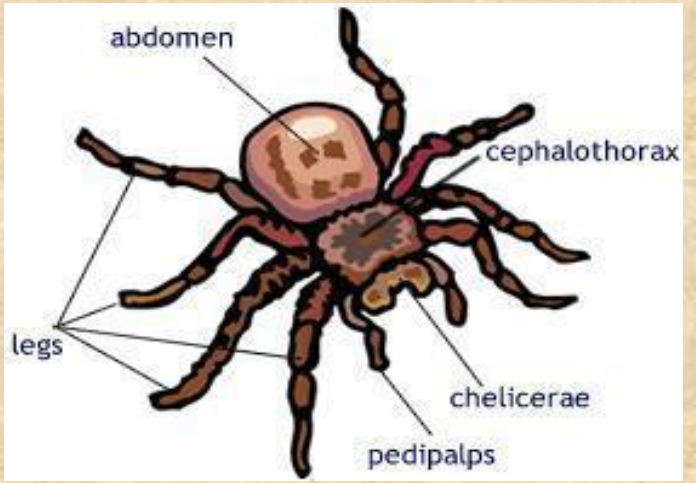
Crustacea

Arachnida

Insecta

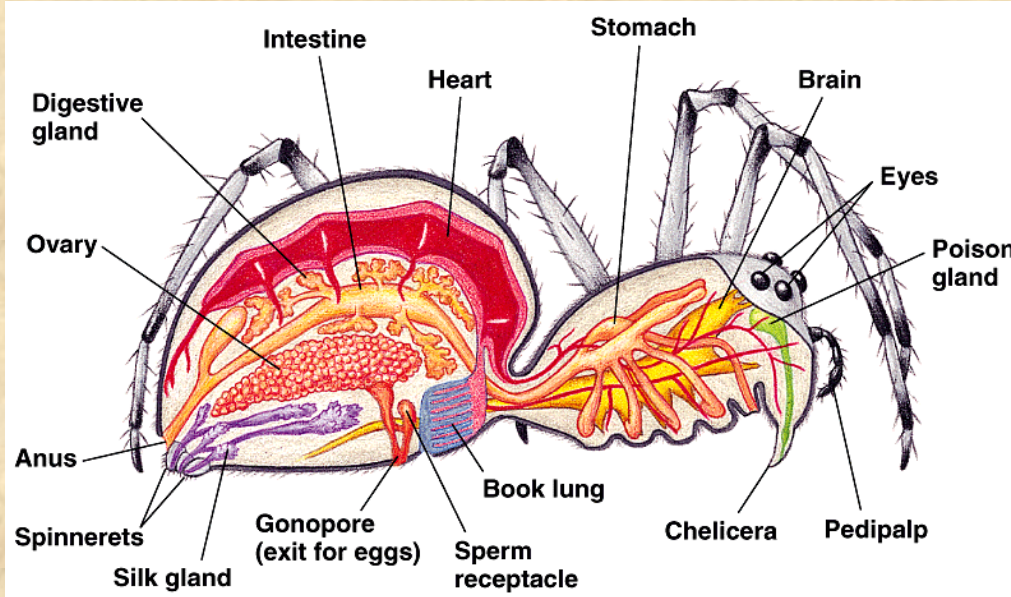
General characteristic and classification of the class Arachnida

The number of species is about 40 000. They adapted for living on land. They have 2 regions of the body: the cephalothorax and abdomen. The body is covered with a cuticle saturated with chitin, the hypodermis is located beneath it. Spiders have silk glands and venomous glands. 6 pairs of appendages are located on the cephalothorax. The first 2 pairs (chelicerae and pedipalps) are used to grasp and to fragmentize food. The rest 4 pairs are walking legs.



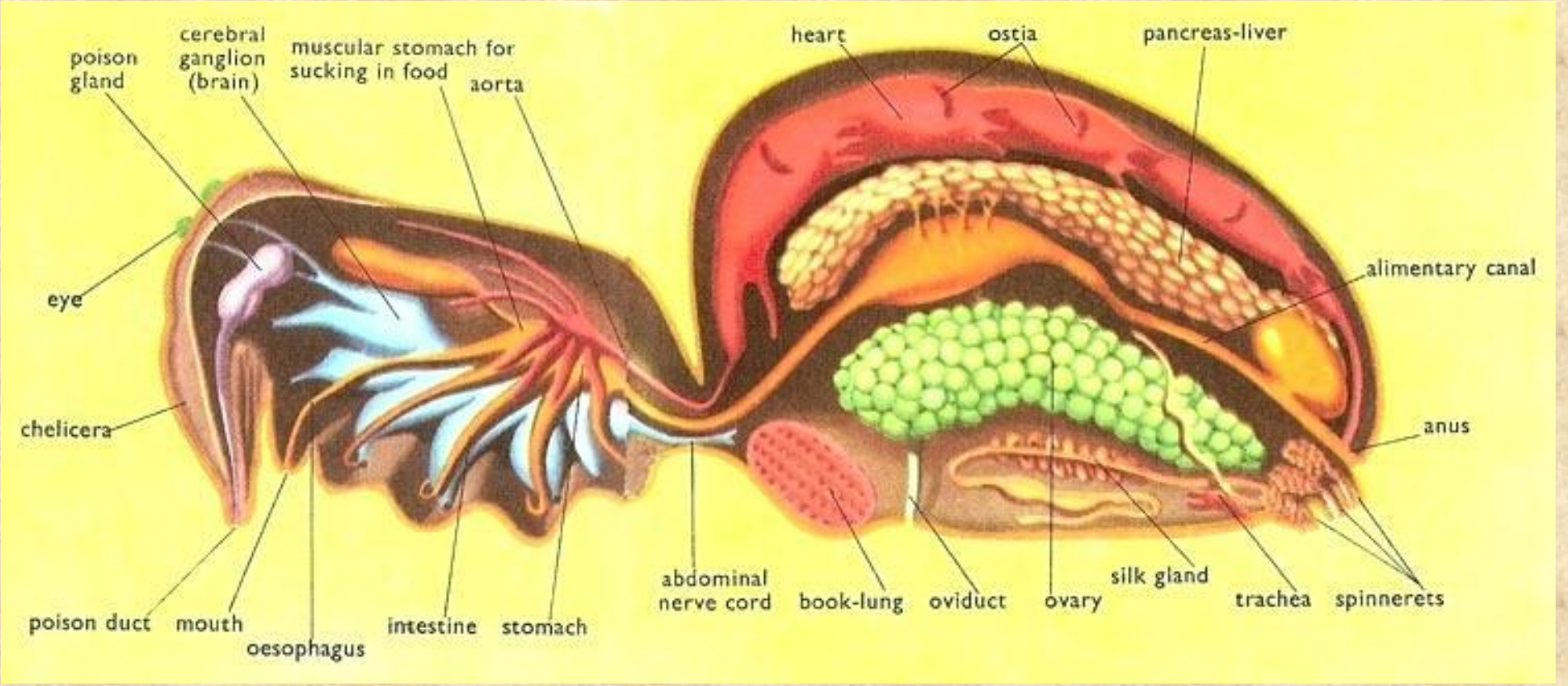
The *digestive system* is adapted for feeding semi-fluid food. *Excretory organs* of arachnids are coxal glands and Malpighian tubules. *Respiratory organs* are book lungs and trachea.

The circulatory system is open. There is a tube-shaped heart with *ostia* (3–7 pairs) that acts as non-return valves allowing blood to enter the heart and prevent it from leaving, 2 short aortae (anterior and posterior) and lateral arteries branching from heart. The hemolymph contains *hemocyanin*.



(b) Anatomy of a spider

The nervous system consists of a cerebral ganglion that performs functions of the brain, ventral nerve chord and nerves. Sensory organs are simple eyes, organs of smell and chemical taste. Arachnids are dioecious. Sexual dimorphism is marked. Reproduction is sexual, development is direct or indirect (with metamorphosis).



Orders:
Scorpions (Scorpiones),

Spiders (Araneae),

Ticks (Acarina)

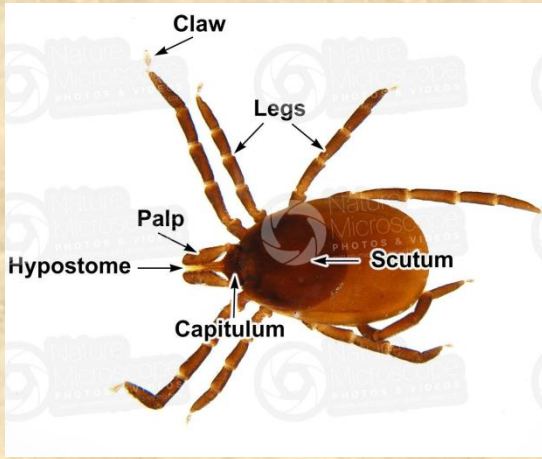
Acari (or Acarina) is a group of arachnids that contains ticks and mites.

Classification: phylum Arthropoda, class Arachnida, order Acarina, families: Ixodidae, Argasidae, Gamasidae, Tyroglyphidae, Sarcoptidae.

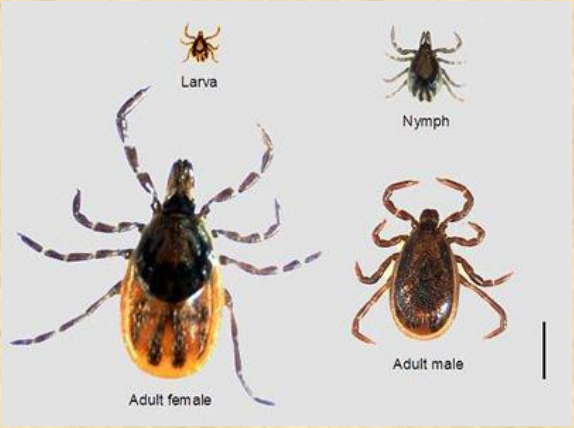
Family Ixodidae

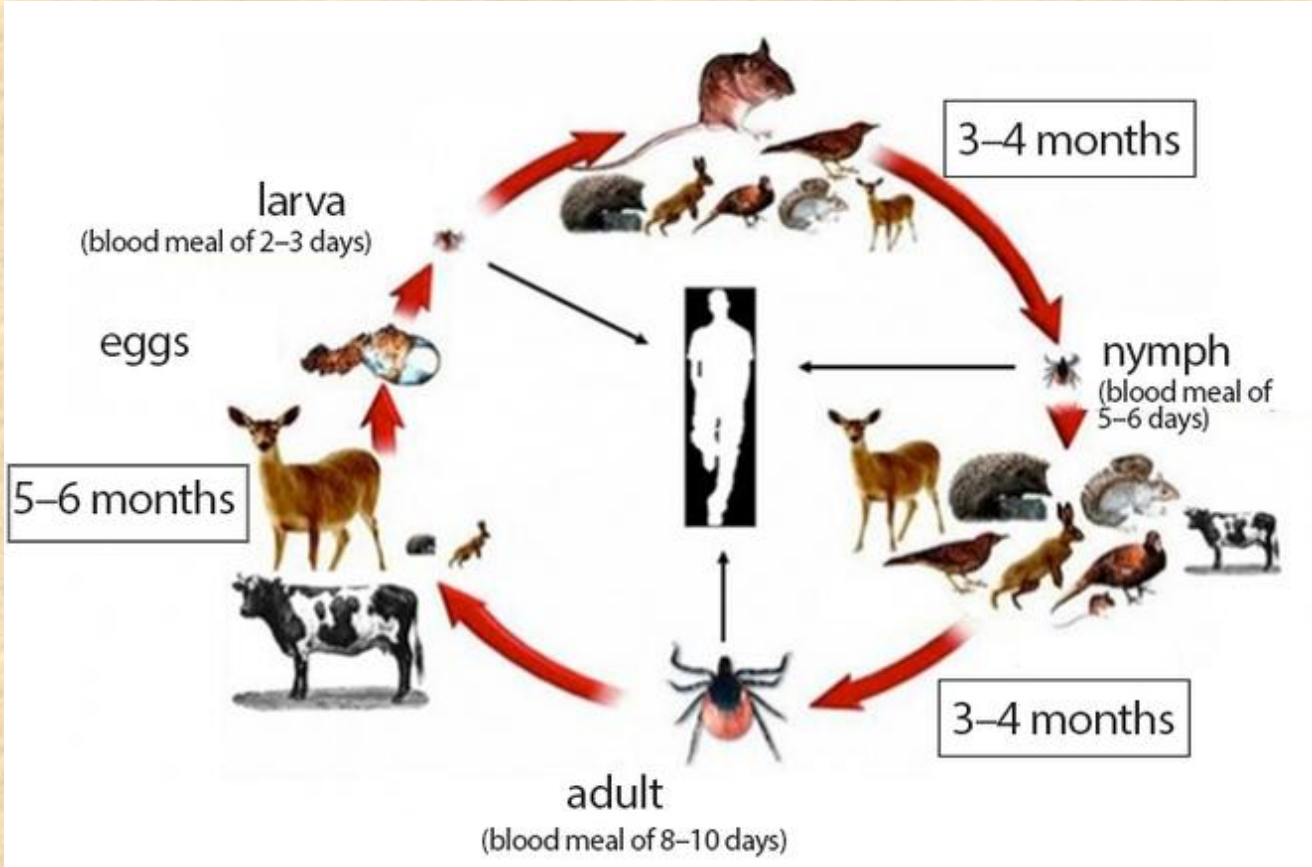
Representatives: Ixodes ricinus or a **castor bean tick**, **Ixodes persulcatus** or the **taiga tick**, **Dermacentor pictus**, **Dermacentor marginatus, Hyalomma anatolicum**.

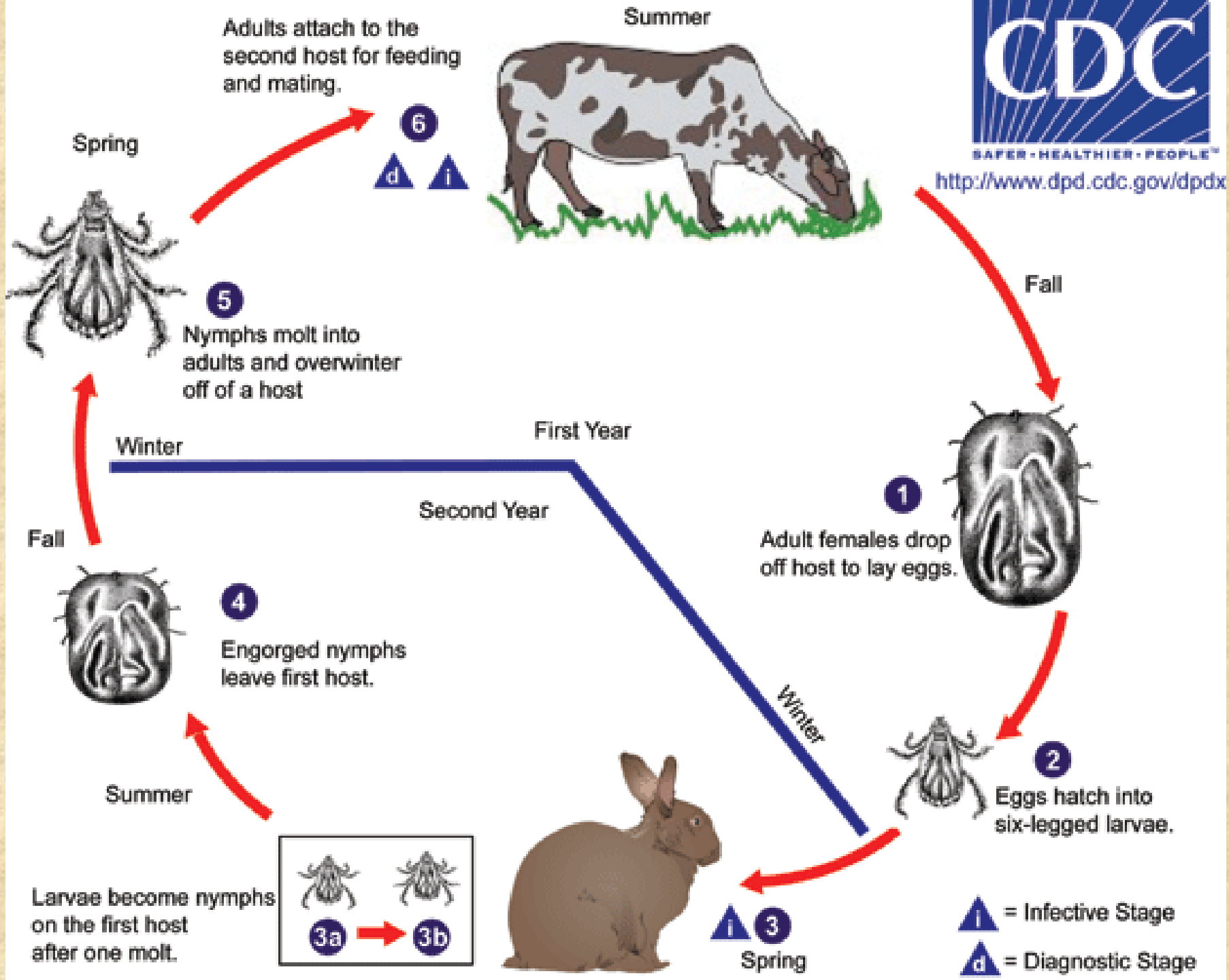
Morphology: the body sizes are from 5 to 25 mm. They inhabit forests and steppe. The body is dorso-ventrally flattened and has no regions. There are 1 pair of eyes and 4 pairs of walking legs. The first 2 pairs of appendages are transformed into mouthparts of a piercing-sucking type. Mouthparts of ticks are sometimes called capitulum. It is located terminally on the anterior end of the body and can be seen from the dorsal side. There is a chitin «shield» (scutum) covering the whole dorsal side in a male and only the frontal part of the back in a female. This provides greater elasticity of the female's abdomen during blood sucking. Ixodes ticks have dark-brown scutum; Dermacentor ticks have scutum with marble appearance.



Life cycle: ticks go through four life stages: **egg, six-legged larva, eight-legged nymph, and adult (imago)**. After hatching from the eggs, ticks must feed on blood at every stage to survive. Blood meal lasts up to several days. The ticks can starve up to 3 years. Their bites are painless, as saliva contains anesthetics. The female lays about 17 000 eggs in soil, in bark of dead trees.






Summer
Adults attach to the second host for feeding and mating.
6
d
i
Spring
5
Nymphs molt into adults and overwinter off of a host
Fall
First Year
Winter
Second Year
Fall
4
Engorged nymphs leave first host.
Summer
Larvae become nymphs on the first host after one molt.
3a
3b
i
3
Spring
Winter
2
Eggs hatch into six-legged larvae.
1
Adult females drop off host to lay eggs.
CDC
SAFER·HEALTHIER·PEOPLE™
http://www.dpd.cdc.gov/dpdx
i = Infective Stage
d = Diagnostic Stage

Medical significance: they are specific vectors of the *tick-borne encephalitis*. The encephalitis virus (family Flaviviridae) affects salivary glands and gonads of ticks. Encephalitis is transmitted by the bite of tick (from tick to human) and transovarially (from tick to its larva). Reservoirs of the encephalitis virus are birds and rodents. Ixodes ticks also transmit *viral hemorrhagic fevers, brucellosis, typhus, plague and tularemia*. Ticks of the genus Dermacentor transmit a virus of Scotland encephalitis.

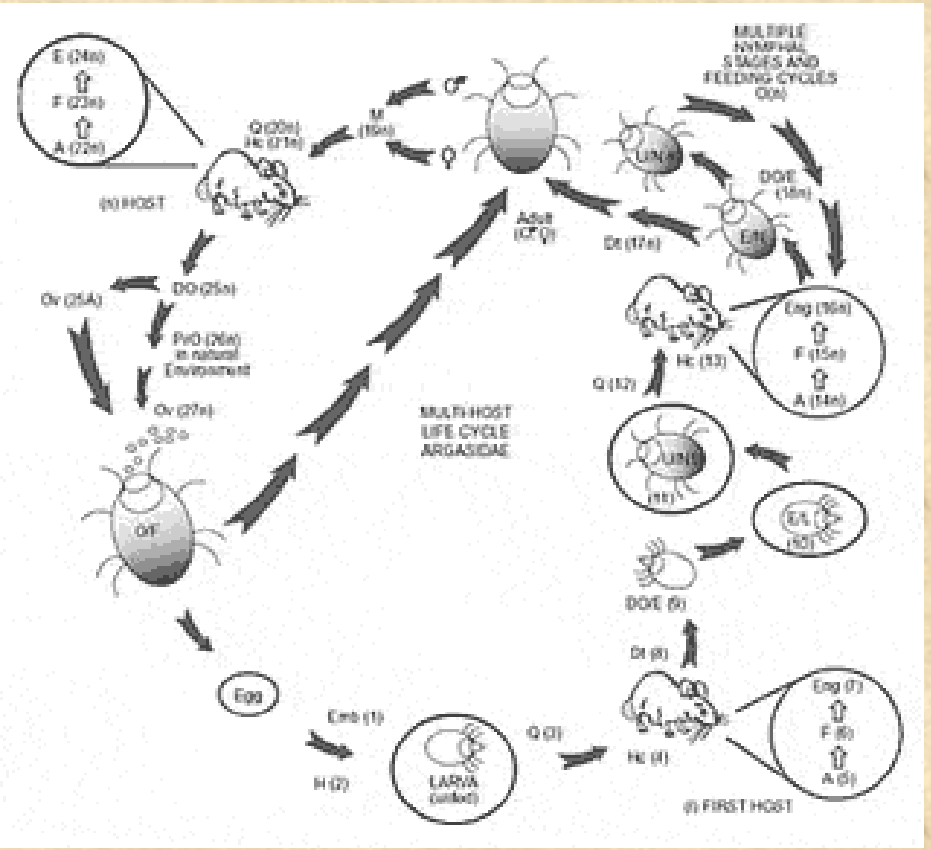
Protective measures against ticks: while walking in a forest travelers can minimize areas of exposed skin by wearing long-sleeved shirts, long pants, and hats. Tucking shirts, tucking pants into socks, using repellents may reduce risk. Travelers should examine the clothes and the body to remove ticks after going to the forest.

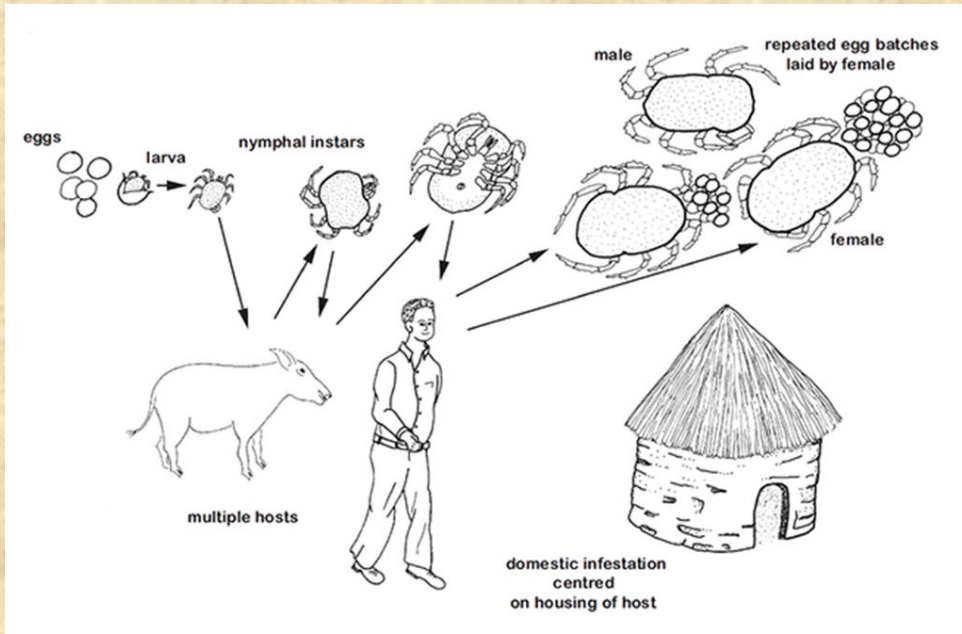
Family Argasidae

Representatives: Ornithodorus papillipes, **Argas percicus** or the **poultry tick.**

Morphology: the body sizes are from 2 to 30 mm. A scutum is absent. The capitulum is located on the underside of the body and can not be seen from the dorsal side. There is a marginal welt. Eyes are absent.

Life cycle: argasidae ticks inhabit caves, holes of rodents, abandoned buildings. Blood meal lasts about 50 minutes. Ticks can starve up to 12–15 years. Females lay 50–200 eggs. There are several stages of nymphs. Transovarial transmission of pathogens is possible.





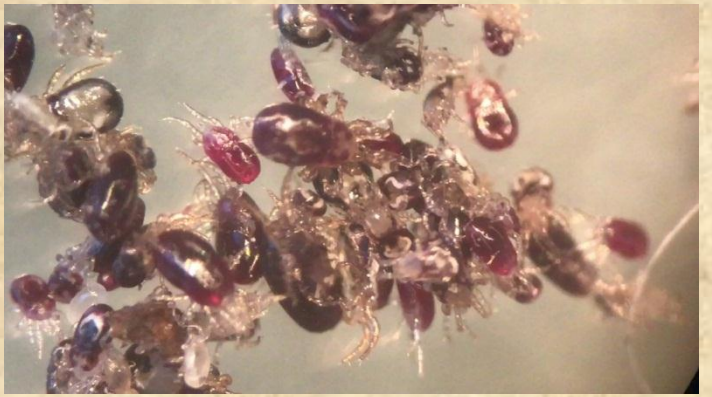
Medical significance: argasidae ticks are specific vectors of a *tick-borne relapsing fever* — infection caused by bacteria in the genus *Borrelia*. Natural reservoirs of the pathogen are cats, dogs and wild rodents. The saliva of argasidae ticks is toxic, their bites may cause dermatitis.

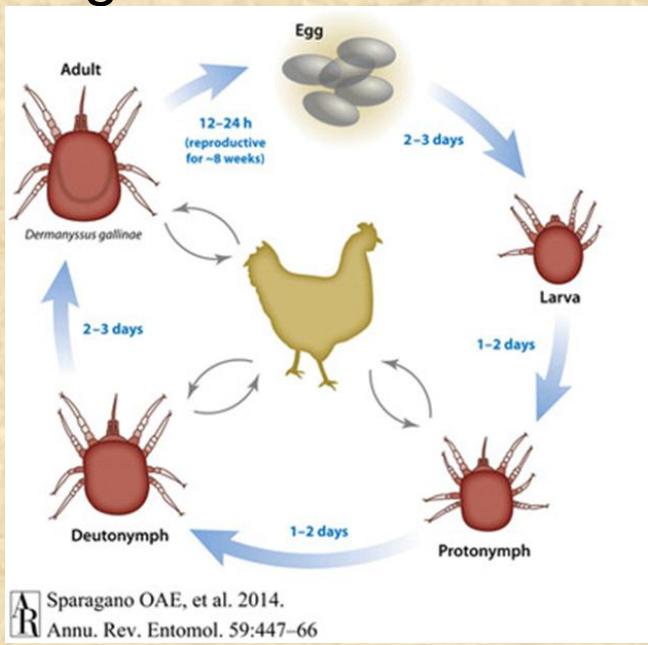
Family Gamasidae

Representative: Dermanissus gallinae or the **chicken mite**.

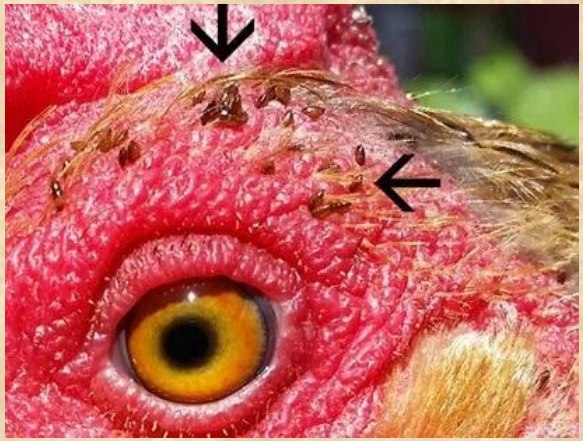
Morphology: Body sizes are from 0.2–0.3 mm. The body is covered with bristles. Eyes are absent.

Life cycle: gamasidae ticks inhabit holes of rodents, nests of birds. Females feed on blood and then hide away from daylight and lay eggs. From nests of pigeons they can get to human habitation through ventilation pipes.





Medical significance: they are permanent or temporary ectoparasites. The saliva of argasidae ticks is toxic and causes dermatitis. If they get into respiratory tract, they cause asthmatic symptoms. Argasidae ticks transmit pathogens of *tick-borne encephalitis, viral hemorrhagic fevers, plague and tularemia*.



Tyroglyphidae family

Representative: Tyroglyphus farinae (flour mite).

Morphology: the body of a slightly-yellow color, sizes are 0.4–0.7 mm, has no eyes.

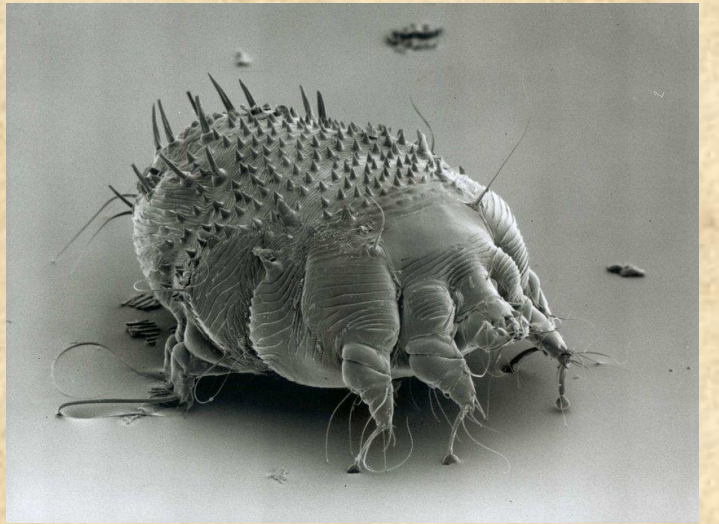
Tyroglyphus ticks may inhabit granary (flour, groats, corn, cheese, etc.), spoil grain and seeds with their excretions.

Medical significance: eating contaminated food may cause diarrhea, catarrhal symptoms of the gastrointestinal tract. During harvesting ticks may get into respiratory tract and cause asthmatic symptoms or bite a human and cause *grain itch*.

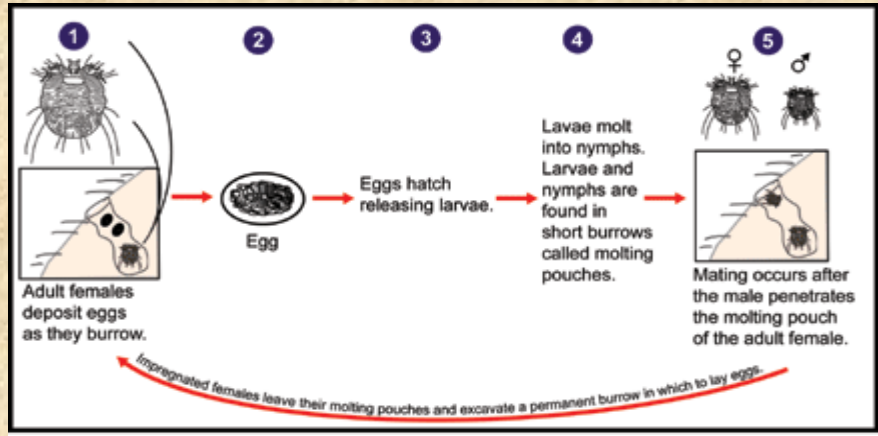
Sarcoptidae family

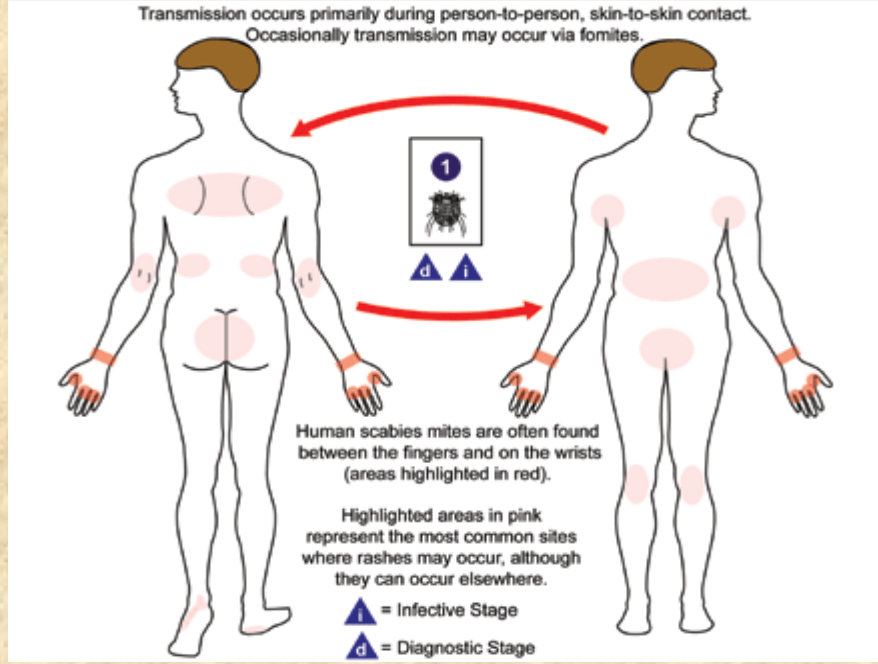
Representative: **Sarcoptes scabiei (itch mite).**

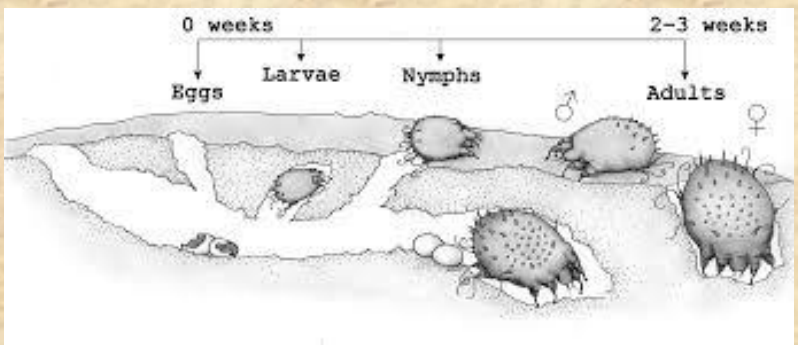
Morphology: the mites have wide, oval, slightly-yellow colored body, covered with bristles. The body sizes are from 0.3–0.4 mm, legs are conical-shaped and shortened, eyes are absent. They breathe with the whole body surface.



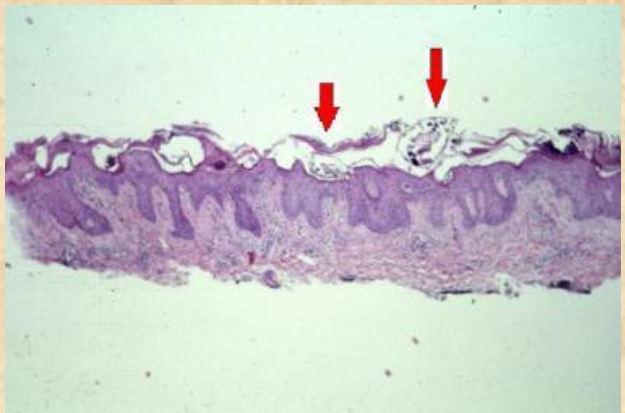
Life cycle: Sarcoptes scabiei is permanent parasite of the human that burrows into skin and causes *scabies*. Fertilized female burrows into the stratum corneum of the skin per 2 mm a day and lays about 50 eggs in the burrow. Males do not burrow the skin. The mites feed on the host's tissues. The development from an egg to an imago takes about 1–2 weeks. Adult mites live up to 2 months.

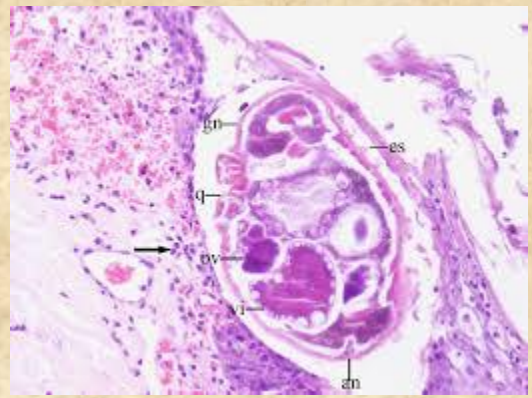






Medical significance: the most common symptom is severe itchiness becoming worse at night. These symptoms can be present across most of the body or just certain areas such as the wrists, between fingers, or along the waistline. Scabies is spread during a direct skin contact with a sick person or their clothes. Secondary infection may get in scratches and cause suppuration.





Prophylaxis of scabies: following basic hygiene rules in communicating with sick people; maintaining the purity of the body; revealing and treating sick persons; sanitary inspection of hostels and bathhouses.

The study of Yevgeny Pavlovsky about the natural foci of vector-borne diseases. Characteristics of a natural focus.

The diseases are called **vector-borne** if their pathogens are transmitted by blood-sucking arthropods.

Transmission of a pathogen occurs during blood meal through a proboscis (*inoculation*), through the host's skin by vector's feces containing pathogens (*contamination*).

Many blood-sucking arthropods are characterized by transmition of the patogen through eggs during sexual reproduction (*transovarially*) from mature arthropod to it larvae.

Pathogens undergo definite development stages in the organism of **specific vector** (malaria parasites develop in Anopheles mosquitoes). **Mechanic vector** (flies, cockroaches) transmit pathogens on the body surface or mouthparts.

Obligate vector-borne diseases are transmitted only by a vector (leishmaniasis). *Facultative vector-borne diseases* (plague, tularemia, anthrax) are transmitted by the vector and in other ways (alimentary or respiratory transmission routes).

A vector-borne disease is characterized by 3 components:

1) pathogen (parasite);

2) host;

3) vector (arthropod).

Natural focus and it structure

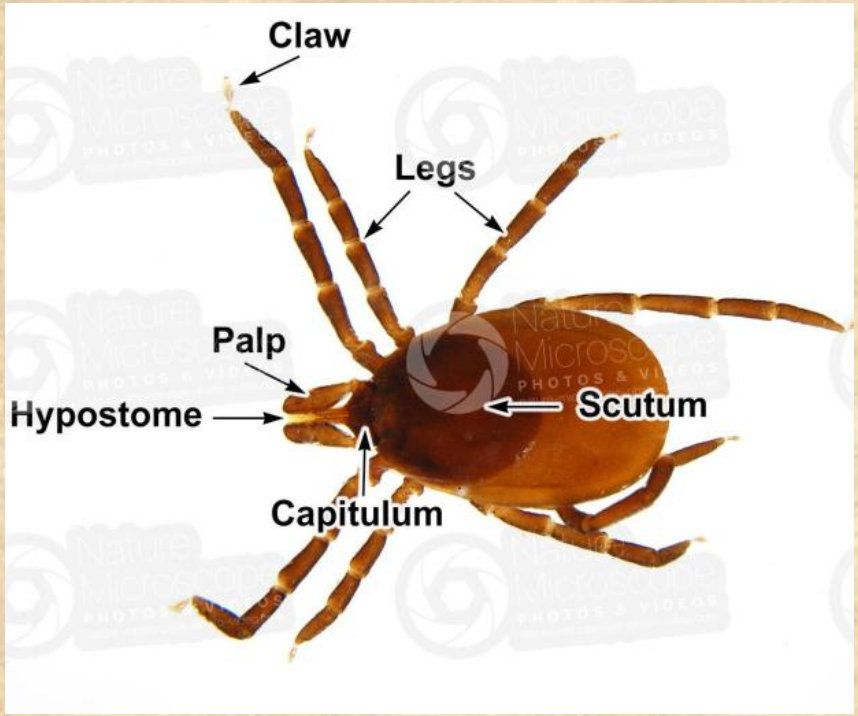
In 1940 Yevgeny Pavlovsky formulated a **study about natural foci of vector-borne diseases**. A natural focus is a definite geographic territory, where circulation of the pathogen from a donor to a recipient occurs through a vector. *Donors of a pathogen* are sick animals, *recipients of a pathogen* are healthy animals, which become donors after getting infected.

Write down in your drawing book classification of **Ixodes ricinus**, **Ixodes persulcatus**, **Dermacentor pictus**, **Dermacentor marginatus, Ornithodorus papillipes, Sarcoptes scabiei.**

You must draw in your drawing book

1. **Ixodes persulcatus**,
2. **Ornithodorus papillipes,**
3. **Sarcoptes scabiei. (see next slide)**

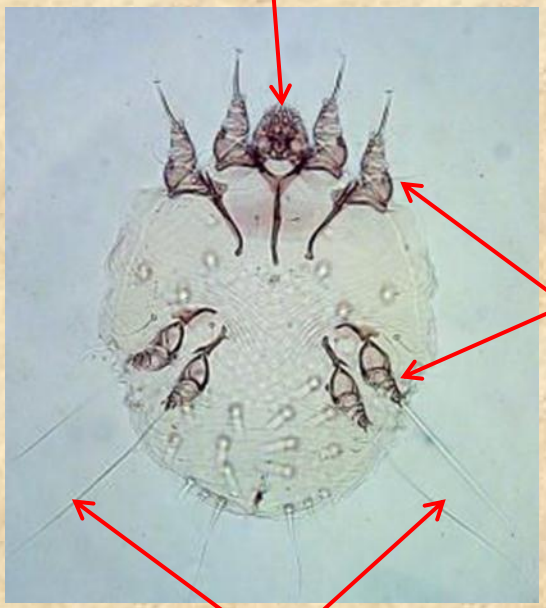
1.


Claw
Legs
Palp
Hypostome
Scutum
Capitulum

2.


marginal welt
mouthparts
legs

3.


mouthparts
legs
bristles

Please follow the link and run the test

https://forms.gle/mBMejQENMqBJsg1A7