MEDICALLY IMPORTANT ARTHROPODS
Chelicerata (Arachnida)

- Spiders

  - Venomous spiders may be classified as those that cause
    - systemic arachnidism
    - necrotic arachnidism.

- Systemic arachnidism:

  - tarantulas (hairy spiders of the tropics and subtropics)
  - black widow spiders.
Black Widow Spiders

Venom:
- a potent peripheral neurotoxin
Healthy adults usually recover,
but small children or weakened people suffer considerably from these bites and may die without treatment!!!!!
Muscle spasms may be severe and may require the intravenous administration of calcium gluconate or other muscle relaxant agents.

If a specific antivenin is available and remains the treatment of choice. It is valuable if given shortly after the bite!!!!
Brown Recluse Spiders

- The venom injected by the female or male spider is a **necrotoxin** (that may also have hemolytic properties) and causes necrotic lesions with deep tissue damage. Humans are bitten only when the spider is threatened or disturbed.
What should be done for a bite:

- Cleanse the bite wound
- Providing tetanus prophylaxis
- Antibiotics to prevent secondary infection
- Healing is generally uncomplicated
Excision and skin grafting may be necessary for bites that have not healed in 6 to 8 weeks.

Systemic therapy with corticosteroids may be useful in treating the hemolytic syndrome.
Scorpions

- When the scorpion is disturbed, it uses the stinger for defense.
- Both male and female scorpions can sting. Venom is injected through the stinger from two venom glands in the abdomen.
Children under the age of 5 years are most likely to be fatally stung by scorpions!

Scorpions are nocturnal, and during the day they remain concealed under logs, rocks, and other dark, moist places. They invade human habitations at night, where they may hide in shoes, towels, clothing, and closets.
The effect of a scorpion sting in a patient is highly variable and depends on factors such as:
  - the species and age of the scorpion,
  - the kind and amount of venom injected, and
  - the age, size, and sensitivity of the person who was stung.

Although the sting of many scorpions is relatively nontoxic and produces only local symptoms, other stings may be quite serious.

Scorpions produce two types of venom
  - a neurotoxin
  - a hemorrhagic hemolytic toxin.
Local or systemic signs and symptoms coupled with physical evidence of a single point of skin penetration are usually sufficient to establish the diagnosis.

An entomologist or parasitologist should be consulted if there is a taxonomic question.
The management of scorpion stings varies. In the absence of systemic symptoms, palliative treatment may be all that is necessary. Pain may be relieved by analgesics or local injection of Xylocaine; however, opiates appear to increase toxicity.

Local cryotherapy may reduce swelling and retard the systemic absorption of the toxin. Hot packs produce vasodilatation and may accelerate toxin distribution systemically and are therefore contraindicated.
Antivenin is available and is effective if administered soon after the sting. Very young children with systemic symptoms should be treated as medical emergencies. Systemic symptoms and shock should be treated supportively.

The use of chemical pesticides to reduce scorpion populations. Removal of debris around dwellings can reduce hiding and breeding places.
Mites

- Small, eight-legged arthropods characterized by a saclike body and no antennae. A large number of mite species are free-living or are normally associated with other vertebrates (e.g., birds, rodents) and may cause dermatitis in humans on rare occasions.

- The number of mites that are considered true human parasites or present real medical problems is quite small and include the human itch mite (Sarcoptes scabiei), the human follicle mite (Demodex folliculorum), and the chigger mite.

- Mites affect humans in three ways: by causing dermatitis, by serving as vectors of infectious diseases, and by acting as a source of allergens.
Scabies

- is cosmopolitan in distribution, with an estimated global prevalence of about 300 million cases. The mite is an obligate parasite of domestic animals and humans; however, it may survive for hours to days away from the host, thus facilitating its spread.

- Transmission is accomplished by direct contact or by contact with contaminated objects such as clothing.

- Sexual transmission has been well documented. Spread of the infection to other areas of the body is accomplished by scratching and manual transfer of the mite by the affected person.

- Scabies may occur in epidemic fashion among people in crowded conditions such as daycare centers, nursing homes, military camps, and prisons.
The standard, and very effective, treatment for scabies is 1% gamma benzene hexachloride (lindane) in a lotion base. One or two applications (head to toe) at weekly intervals is effective against scabies. Lindane is absorbed through the skin, and repeated applications may be toxic. For this reason, it is not advisable to use it in treating infants, small children, or pregnant or lactating women.

Recently, a 5% permethrin cream (Elimite) has replaced lindane lotions as the treatment of choice for scabies. Clinical trials have shown permethrin to be more effective and less toxic than lindane.

Other preparations used to treat scabies include crotamiton sulfur (6%) preparations, benzyl benzoate, and tetraethylthiuram monosulfide.
Primary prevention of scabies is best achieved with good hygiene habits, personal cleanliness, and routine washing of clothing and bed linens.

Secondary prevention includes the identification and treatment of infected people and possibly their household and sexual contacts. In an epidemic situation, simultaneous treatment of all affected people and their contacts may be necessary. This is followed by thorough cleansing of the environment (e.g., boiling clothing and linens) and ongoing surveillance to prevent re-occurrence.
Human Follicle Mites

- include two species of the genus *Demodex*:
  - *D. folliculorum* and *D. brevis*. 
Factors such as poor personal hygiene, increased sebum production, mite hypersensitivity, and immunosuppression may increase host susceptibility and enhance the clinical presentation of *Demodex* infestation. Most people infested with these mites remain asymptomatic.

Mites may be demonstrated microscopically in material expressed from an infested follicle. They may be seen as incidental findings in histologic sections of facial skin.

Effective treatment consists of a single application of 1% gamma benzene hexachloride.
Chigger Mites

- Chiggers are a particular problem for outdoor enthusiasts such as campers and picnickers. In Europe and the Americas, they are associated with intensely pruritic lesions; however, in Asia, Australia, and the western Pacific rim, they serve as vectors of the rickettsial disease scrub typhus or tsutsugamushi fever (*Rickettsia tsutsugamushi*).
Ticks

- bloodsucking ectoparasites of a number of vertebrates, including humans.
- opportunistic rather than host specific and tend to suck blood from a number of large and small animals.
- four-stage life cycle that includes the egg, larva, nymph, and adult. Although the larva, nymph, and adults are all bloodsuckers, it is the adult tick that usually bites humans.
- comprise two large families, the Ixodidae, or hard ticks, and the Argasidae, or soft ticks.
Hard tick

- Rocky Mountain spotted fever \textit{(Dermacentor species)}, tularemia \textit{(Dermacentor species)}, Q fever \textit{(Dermacentor species)}, \textbf{Lyme disease} \textit{(Ixodes species)}, babesiosis \textit{(Ixodes species)}, and ehrlichiosis \textit{(D. variabilis} and \textit{A. americanum)}

Soft ticks

- of the genus \textit{Ornithodoros} transmit relapsing fever spirochetes \textit{(Borrelia species)} in limited areas in the West. In general, people at risk for tick exposure are involved in outdoor activities in wooded areas. Tick exposure may also occur during stays in rural cabins inhabited by small rodents, which commonly serve as hosts for ticks and other ectoparasites.
Ticks may attach at any point on the body but typically favor the scalp, hairline, ears, axillae, and groin. The initial bite is usually painless, and the presence of the tick may not be detected for several hours after contact.

After the tick has dropped off or has been removed manually, the area may become reddened, painful, and pruritic. The wound may become secondarily infected and necrotic, particularly if the mouthparts remain attached after manual removal.
Three species of tick, *D. andersoni*, *D. variabilis*, and *A. americanum*, have all been reported to cause **tick paralysis**.

Ticks are also involved in the transmission of infections such as Lyme disease, Rocky Mountain spotted fever, ehrlichiosis, Colorado tick fever, relapsing fever, tularemia, Q fever, and babesiosis. The identification of an organism as an adult tick is usually straightforward and based on the observations of an organism that is dorsoventrally flattened and possesses four pairs of legs and no visible segmentation.
An entomologist or parasitologist should be consulted if further identification is desired.

**Treatment, Prevention, and Control**

Early removal of attached ticks is of primary importance and may be accomplished by steady traction on the tick body, grasped with forceps as close to the skin as possible.

Care should be taken to avoid twisting or crushing the tick, which may leave the mouthparts attached to the skin or inject potentially infectious material into the wound.

Because ticks may harbor highly infectious agents, the clinician should use appropriate infection-control precautions (e.g., use of gloves, handwashing, proper disposal of ticks and contaminated material) during tick removal.

Preventive measures used in tick-infested areas include the wearing of protective clothing that fits snugly about the ankles, wrists, waist, and neck so that ticks cannot gain access to the skin. Insect repellents such as N,N-9-diethyl-m-toluamide (DEET) are generally effective. People and pets should be inspected for ticks after visits to tick-infested areas.
The insects, or *hexapods*, constitute the largest and most important of all the classes of arthropods, accounting for approximately 70% of all known species of animals. Insects include animals such as mosquitoes, flies, fleas, lice, roaches, bees, wasps, beetles, and moths to name just a few.
Bloodsucking Diptera

All dipterans have a single pair of functional membranous wings and various modifications of the mouthparts, which have been adapted for piercing the skin and sucking blood or tissue juices. Their most important feature is their role as mechanical or biologic vectors of a number of infectious diseases, including leishmaniasis, trypanosomiasis, malaria, filariasis, onchocerciasis, tularemia, bartonellosis, and the viral encephalitides.

The bloodsucking flies include mosquitoes, sand flies, and blackflies, all of which are capable of transmitting diseases to humans. Other dipterans, such as horse flies and stable flies, are capable of inflicting painful bites but are not known to transmit human pathogens.

Although the common housefly does not bite, it certainly is capable of mechanical transmission of a number of viral, bacterial, and protozoan infections to human hosts.
Mosquitoes

- Adult mosquitoes are small and have delicate legs, one pair of wings, long antennae, and greatly elongated mouthparts adapted for piercing and sucking. The two major families of mosquitoes (Culicidae), the Anophelinae and the Culicinae, share a number of similarities in their life cycles and development.

- They lay eggs on or near water, are good fliers, and feed on nectar and sugars. The females of most species also feed on blood, which they require for each clutch of 100 to 200 eggs. Females may take a blood meal every 2 to 4 days. In the act of feeding, the female mosquito injects saliva, which produces mechanical damage to the host but also may transmit disease and produce immediate and delayed immune reactions.

- the genus *Anopheles* contains the species responsible for the transmission of human malaria. In the tropics, these mosquitoes breed continually in relation to rainfall. *A. aegypti*, the yellow fever mosquito, usually breeds in man-made containers (flower pots, gutters, cans) and is the primary vector of yellow fever and dengue in urban environments throughout the world.
Preventive measures in mosquito-infested areas include the use of window screens, netting, and protective clothing. Insect repellents such as DEET are generally effective. Mosquito-control measures that involve the use of insecticides have been effective in some areas.
Ceratopogonids represent an assortment of tiny flies with names such as gnats, midges, and punkies. The majority of the flies that attack humans belong to the genus *Culicoides*; they are minute (0.5 to 4 mm long) and slender enough to pass through the fine mesh of ordinary window screens. The females suck blood and typically feed at dusk, when they may attack in large numbers.

Biting midges may be important pests in beach and resort areas near salt marshes. Those of the genus *Culicoides* are the main vectors of filariasis in Africa and the New World tropics.

The mouthparts of biting midges are lancet-like and produce a painful bite. Bites may produce local lesions lasting hours or days.

Local treatment is palliative, with lotions, anesthetics, and antiseptic measures. The treatment of breeding sites with pesticides and repellents may be useful against some of the common species of these pests.
Myiasis-Causing Flies

- Myiasis is the term applied to the disease produced by maggots that live parasitically in human tissues. Clinically, myiasis may be classified according to the body part involved (e.g., nasal, intestinal, or urinary myiasis). The number of myiasis-producing flies and the diversity in lifestyle requirements are enormous.

- Only the host relations and sites of predilection of some of the more important species are covered in this section.

- One important example is the human botfly, Dermatobia hominis, which is found in the humid regions of Mexico and Central and South America. The adult botfly attaches her eggs to the abdomen of bloodsucking flies or mosquitoes, which in turn distribute the eggs while obtaining a blood meal from an animal or human.

- The larvae enter the skin through the wound created by the biting insect. The larvae develop over 40 to 50 days, during which time a painful lesion known as a warble appears. When the larvae reach maturity, they leave the host to pupate. The resulting lesion may take weeks to months to heal and may become secondarily infected. If the larva dies before leaving the skin, an abscess forms.
Sucking Lice Body

- only the body louse is important in medicine as the vector of the rickettsia of typhus and trench fevers and the vector of the spirochetes of relapsing fever

- The body louse, *Pediculus humanus*, and the head louse, *P. humanus capitis*, are elongated, wingless, flattened insects with three pairs of legs and mouthpieces adapted for piercing flesh and sucking blood.

- The pubic or crab louse, *Phthirus pubis*, has a short, crablike abdomen with clawed second and third legs.

- Epidemics of head lice are reported frequently in the United States, particularly among school children. The head lice inhabit the hairs of the head and are transmitted by physical contact or sharing of hairbrushes or hats. Crab lice survive on blood meals around the hairs of the pubic and perianal areas of the body.

- They are transmitted frequently from one person to another by sexual contact and contaminated toilet seats or clothing. Body lice are usually found on clothing. Unlike head or crab lice, they move to the body for feeding and return to the clothing after obtaining a blood meal. All of the lice inject salivary fluids into the body during the ingestion of blood, which causes varying degrees of sensitization in the human host.
Intense itching is the usual characteristic of infestation by lice (pediculosis). The patient may have pruritic, red papules around the ears, face, neck, or shoulders. Secondary infection and regional adenopathy may be present.

The eggs, or nits, are white, round objects that may be found attached to the hair shafts (head and crab lice) or on clothing (body lice).

Gamma benzene hexachloride (lindane) lotion applied to the entire body and left on for 24 hours is an effective treatment for lice.

Shaving the hair of affected areas is a desirable adjunct. Adult lice in clothing must be destroyed by the application of lindane or DDT powder or by boiling.

Lice may survive in the environment for up to 2 weeks; thus items such as brushes, combs, and bedding must be treated with a pediculicide or by boiling.

The best strategy for primary prevention is education and practice of good hygiene habits. Secondary prevention may be practiced by a policy of routine surveillance (e.g., scalp inspections) in schools, daycare centers, military camps, and other institutions. Repellents may be necessary for people who run a high risk of exposure in crowded conditions.
Head Louse  Pubic Louse
Fig. 134. Pediculosis capitis (Secondary bacterial infections)
Fleas

- small, wingless insects with laterally compressed bodies and long legs adapted for jumping
- Fleas are cosmopolitan in distribution. Most species are adapted to a particular host; however, they can readily feed on humans, particularly when deprived of their preferred host.
- Fleas are important as vectors of plague and murine typhus and as intermediate hosts for dog (*Dipylidium caninum*) and rodent (*Hymenolepis* species) tapeworms that occasionally infect humans.
Bugs

- two bloodsucking insects:
  - bedbug
  - triatomid bug.
Note: Bed bugs take 3-10 minutes to complete feeding.

- **Egg** (1mm long)
  - Takes a blood meal then molts.

- **First Stage Larva** (1.5 mm long)
  - Takes a blood meal then molts.

- **Second Stage Larva** (2 mm long)
  - Takes a blood meal then molts.

- **Third Stage Larva** (2.5 mm long)
  - Takes a blood meal then molts.

- **Fourth Stage Larva** (3 mm long)
  - Takes a blood meal then molts.

- **Fifth Stage Larva** (4.5 mm long)
  - Takes a blood meal then molts.

- **Adult** (5.5 mm long)
  - Take repeated blood meals over several weeks.
  - Females lay up to 5 eggs per day, continuously.

**Life Cycle of the Bed Bug**
*Cimex lectularius*
Triatomid bugs are important vectors of Chagas' disease. Lesions range from small, red marks to hemorrhagic bullae. Triatomid bugs bite with higher frequency on the face. The classic periorbital edema secondary to a triatomid bite is known as Romaña's sign. Antihistamines may be indicated if dermatitis is severe. Control consists of proper hygiene and the environmental applications of insecticides.
order Hymenoptera

comprises the **bees**, **wasps**, **hornets**, and **ants**.
Severe toxic reactions such as fever and muscle cramps can be caused by as few as 10 stings.

Anaphylactic shock from bee stings has resulted in death in some instances.

No satisfactory treatment has been discovered for stings. If left in the wound, the sting apparatus should be removed immediately. The injection of epinephrine is sometimes necessary to counteract anaphylaxis.

Although there are no effective repellents against these insects, their nests can be destroyed with any of several commercially available insecticidal compounds.