

Synopsis of Phylum Arthropoda (Arthropods)

Identifying Characteristics of Phylum:

- includes: crabs, crawfish, shrimp, spiders, scorpions, mites, ticks, millipedes, centipedes, insects (dragonflies, butterflies, ants, wasps, beetles, etc)
- more species in this phylum than in ANY phylum of ANY kingdom of life
- more widely distributed over the earth than any other animal phylum
- paired jointed appendages** → the only invertebrate with this trait
- hard (sclerotized) exoskeleton** of **chitin** completely covers body; must **molt** to grow
- segmented body**; allows infinite possibilities for adaptive modifications
- well developed **head (cephalization)**
- numerous sense organs; antennae & compound eyes are characteristic sense organs of arthropods
- several pairs of jointed **feeding appendages**
- very **active and energetic animals** → most active invertebrate group; virtually every form of animal movement is found in arthropods: walking, running, crawling, burrowing, swimming, flying,
- were the **first animals to move onto land**; allowed wide and rapid distribution and dissemination
- arthropods have a very **complex muscular system**; some with 1000's of muscles
- virtually every mode of feeding: carnivores, herbivores, omnivores, parasites
- well developed complete digestive tract: **mouth - esophagus - stomach - intestine - anus**
- variety of respiratory systems; **gills, book gills, lungs book lungs, trachea**
- arthropods have a simple **open circulatory system** → coelom a **haemocoel** filled with blood; has dorsal **heart** and blood vessels; blood with pigments to carry oxygen:
- ladderlike nervous system similar to annelids
- well developed sense organs **simple eyes = ocelli, compound eyes, antennae, chemoreceptors, tactile hairs & spines, statocysts**
- arthropods have a variety of efficient excretory systems; **antennal glands, malpighian tubules, coxal glands**, some aquatic forms excrete through **skin** or **gills**
- mostly **dioecious** with lots of variation in developmental stages, a few reproduce **parthenogenetically**

Subphylum: Trilobita

- completely extinct subphylum; 4,000 fossil species; earliest arthropod group
- named for the division of the body into 3 longitudinal lobes
- highly specialized marine bottom dwellers (**benthos**) from shallow flats and reefs to deeper waters
- dominated marine **benthos** for 300 Million years

Subphylum: Myriopoda (centipedes and millipedes)

- long worm-like segmented body divided into a **head** and **trunk**
- head with 1 pair of **antennae** and poorly developed clusters of **ocelli**
- with **paired appendages** on almost all segments
- mostly terrestrial; generally found in moist humus or in damp areas under rocks and logs
- mandibles** for feeding
- insect-like **tracheae** for respiration
- insect-like **malpighian tubules** for excretion
- centipedes**: means "100 feet"; body usually flat in cross-section; one pair of walking legs on most segments; predators with pair of **poison fangs**
- millipedes**: means "1000 feet"; body usually round in cross section; 2 pairs of legs on most "segments"; most are scavengers

Subphylum: Chelicerata

- include horse shoe crabs, sea spiders, scorpions, spiders, ticks, mites, sea scorpions

This is NOT "what's on the test"; this is a summary of the major points from lab and lectures; **the lecture & lab notes** are the sources of exam questions

- most members of the group are **terrestrial** → 1st group of animals to successfully make transition to land
- head is fused to thorax = **cephalothorax**, **abdomen** behind this
- main feeding appendages are **chelicerae** (pincer-like or fang like) used to grab or pierce or tear prey
- most also have second feeding appendage = **pedipalp**
- only arthropod group **without antennae**
- most have **4 pairs of walking legs**
- aquatic species have **book gills**; terrestrial species use **book lungs** or **tracheae**
- aquatic species have **simple** and **compound eyes**; terrestrial species have several pairs of simple eyes
- excretory organ of most Chelicerates are **malpighian tubules** and **coxal glands** at base of some legs
- dioecious; some with elaborate mating rituals; some with considerable parental care

Human Impacts of Chelicerates:

- spiders are directly beneficial as predators → each kill 1000's of insect crop pests
- large infestations of some mites can damage food and ornamental plants by sucking their juices
- venomous species → a **few** are deadly; eg. black widow, eg. brown recluse, eg. scorpions
- arachnid Diseases and Parasites: ticks, mites, chiggers, etc.
- more serious impact on humans is as disease **vectors**: eg mites and ticks
- scientists are experimenting with **venom genes** to use as biological control against insect pests
- spider silk** is being investigated for a variety of possible uses.

Subphylum Crustacea

- shelled creatures; "**the insects of the sea**" eg: lobsters, crayfish, shrimp, crabs, water fleas, copepods, barnacles, pill bugs, etc
- crustaceans are mostly **aquatic**, the great majority are **marine**
- in most crustaceans today, the body is usually divided into a **cephalothorax**, **abdomen** and **tail**
- cephalothorax** usually with **2 pairs of antennae & compound eyes**; often has **carapace** extending over the sides of the animal
- abdomen** usually with pairs of jointed appendages on most segments
- generally have many pairs of appendages; most appendages are **biramous**
- use jaw-like **mandibles** as main feeding structures; also **maxillae** and **maxillipeds**
- great variation in feeding types: predators, suspension feeders, scavengers, etc
- respiration** in small crustacea: no special organs ; in larger crustacea usually with feathery **gills**
- in some crustacea development is direct but most crustaceans produce a variety of distinctive larval forms as the animal develops eg. **nauplius**

Ecological & Economic Impacts of Crustaceans

- crustaceans feed a vast number of other animals in the oceans and in freshwaters
- many symbioses; mutualistic, commensal and parasitic forms
- more than 10 million tons of crustaceans are harvested for food each year (2007)
- crayfish are commonly sold and used as bait either live or only the tail meat
- crayfish** & land crabs are kept as pets
- many crustaceans are serious pests; eg rice crabs, crayfish, barnacles, etc
- many Crustaceans are **endo-** and **ectoparasites** on other organisms
- some act as **intermediate hosts** for human parasites; eg Guinea worm, tapeworms

Subphylum: Hexapoda (insects)

- most successful & widespread group of all life; today insects have spread into **all** major habitats
- were the first animals to fly
- body in three parts: **head**, **thorax** and **abdomen**

- head with** large **compound eyes**, several (usually 3) simple eyes (=ocelli), 1 pair of **antennae**, **mandibles** and other mouthparts for feeding
- thorax** divided into three segments 6 legs; most also have 2 pairs of **wings**
- abdomen** contains reproductive organs; females have **ovipositor** to lay eggs
- great diversity of leg types**; walking, running, jumping, swimming, digging, climbing, grasping
- insects feed upon almost every kind of organic substance; the same basic mouthparts are modified in many ways to facilitate different methods of feeding:
- respiration by **tracheal system with spiracles** → adaptation to air
- they have a rich supply of sense organs located all over the body; these contribute to a rich diversity of insect behaviors
- many insect species exist as colonies eg. ants, bees, wasps, termites, some beetles
- insects defend themselves in a variety of ways; hard exoskeleton, quick reflexes, defensive postures, spines & bristles, use of sound, warning and camouflage colors, chemical defenses, stings
- excretions using **malpighian tubules** to absorb metabolic wastes from blood and drain into intestine
- wide range in life spans for adult insects: hours to years
- insects are **dioecious**; most have **internal fertilization**; mating is an important part of an insect's behavior set; insects usually lay many eggs; some lay eggs on specific plant or animal
- most insects also go through several distinct developmental stages as they grow from egg to adult
- insects often have complex development including **metamorphosis**; most of the rest have **incomplete metamorphosis**
- some insects go dormant in adverse conditions; or **diapause** for extended dormancy

Ecological & Economic Impacts of Insects

- insects are the most important organisms in most terrestrial ecosystems; without insects, most of the terrestrial life on earth would disappear
 - Important in Recycling of nutrients eg. 90% of all dead animals are eaten by ants
- insect pollinators are keystone species in some terrestrial ecosystems
- insects have formed a wide variety of symbioses with virtually every major kind of living organisms
- in the US a 2006 study estimates that insects directly or indirectly contribute more than \$57 Billion to our economy
- some insects have been semi-domesticated: eg honeybees, silkworms, mealworms, crickets
- commercial products; eg. chitin, shellac, dyes
- venomous Insects: ants, bees, wasps, hornets, blister beetles, etc
- parasites & Diseases & Vectors; mosquitoes, bed bugs, lice, fleas, flies
- insect and spider silk is being investigated for a variety of purposes
- insects as food; in many parts of the world, insects are considered delicacies
- blood sucking insect, *Dipetalogaster maximus*, is used as a high tech syringe
- insects as chemical detection devices; “wasp hound” = a portable hand held odor detector
- scientists hope to harness the activities of termite bacteria to break down cellulose to produce ethanol and biofuels