Introduction to Phylum Arthropoda

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Phylum Arthropoda

- Segmented body.
- Paired segmented appendages.
- Bilateral symmetry.
- Chitinous exoskeleton.
- Tubular alimentary canal with mouth and anus.
- Open circulatory system, a tubular dorsal blood vessel.
- Body cavity or coelom.
- Nervous system of anterior ganglia and paired nerve cords.
- Striated muscles in skeletal system.
- Respiration by gills, tracheae, or spiracle.

Phylum Arthropoda

- Insects
- Arachnids (spiders, ticks, mites, etc.)
- Crustaceans
- Millipedes
- Centipedes

CUES, http://www.entomology.umn.edu/cues/IPM-turf/sodwebworms.htm

Sod Webworm Moth,
Crambus sp.

Cottonwood Leaf Beetle,
Chrysomela scripta

Class Crustacea: Crabs, lobsters, sowbugs

- Two main body sections.
- Five to seven pairs of legs.
- Two pairs of antennae.
- Simple eyes.

Crayfish

Class Crustacea: Crabs, lobsters, sowbugs

Pillbugs

Class Chilopoda: Centipedes

- One pair of legs per body segment.
- Flattened body.
- First pair of legs modified as venomous fangs.
- Nocturnal predators.
- Few are dangerous to humans.

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Garden Centipede,
Lithobius forficatus

Class Chilopoda: Centipedes

Georgia Forestry Commission Archives
Georgia Forestry Commission
www.forestryimages.org

Fangs of Scolopendrid Centipede (above)
House Centipede, *Scutigera coleoptrata* (right)

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Class Diplopoda: Millipedes

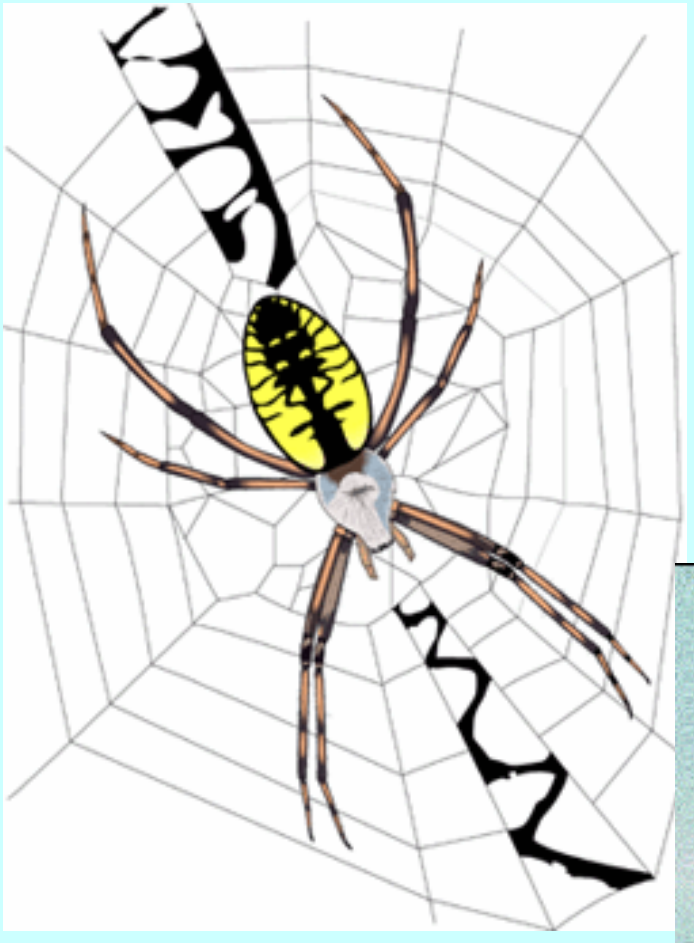
- Two pairs of legs per body segment.
- Cylindrical body.
- Feed on decaying plant material.
- Nocturnal.
- Harmless.

Pet African Giant Millipedes

Class Diplopoda: Millipedes

Photos by William Leonard, Tree of Life Web Project, http://tolweb.org/tree/phylogeny.html

Class Arachnida: Spiders, ticks, mites, harvestman, scorpions, etc.



Yellow Garden Spider

Tick

Mite

Class Arachnida

- Mouthparts are called chelicerae.
- Most contain venom.
- Antennae are absent.
- Four pairs of legs.
- Book lungs for respiration.

Blacklegged Tick, *Ixodes scapularis*

Scott Bauer, USDA Agricultural Research Service, www.insectimages.org

Yellow Garden Spider, *Argiope aurantia*

Class Arachnida: Order Araneae: Spiders

David Cappaert, www.insectimages.org

Jumping Spider, *Phidippus audax*

- Two body regions (cephalothorax, abdomen).
- Fangs (chelicerae), most are venomous.
- Most are not dangerous.
- Most make webs.
- Most have poor eyesight; hairs compensate for it (jumping spiders are an exception).
- Potentially dangerous spiders (bites are uncommon):

  Brown recluse spider, Black widow spider

Class Arachnida: Order Araneae: Spiders

Crab Spider, *Misumenoides formosipes*

James O. Howell, The University of Georgia, www.forestryimages.org

Wolf Spider, *Lycosa carolinensis*

Class Arachnida:
Order Opiliones: Harvestman
(Daddy Longlegs)

- One apparent body region.
- Abdomen and cephalothorax short.
- Common and harmless.
- Nocturnal.
- Feed on detritus, fruit, or other animals.

Leiobunum sp.

Class Arachnida:
Order Scorpiones: Scorpions

- Long tail with sting.
- Pedipalps are modified as pinchers.
- Most scorpion stings are no worse than bee stings; only a minority of species are potentially dangerous.
- Nocturnal.
- Common in warm climates.
- Feed on other animals.

Striped Bark Scorpion,
Centruroides vittatus,
gravid female from Texas

Class Arachnida: Order Scorpiones: Scorpions

Northern Desert Hairy Scorpion, *Hadrurus spadix*, native to US

Emperor Scorpion, *Pandinus imperator*, female eating cockroach, native to West Africa

Class Arachnida:
Order Scorpiones: Scorpions

Arizona Bark Scorpion, *Centruroides exilicauda*, mating

Class Arachnida:
Order Scorpiones: Scorpions

Lined Devil Scorpion,
Vaejovis spinigerus,
female from Arizona with young

Flat Rock Scorpion,
Hadogenes troglodytes,
female, native to
South Africa

Class Arachnida:
Order Scorpiones: Scorpions

Slenderbrown Bark Scorpion,
Centruroides gracilis,
male from Central America

Pandinus imperator; scorpions glow under UV/ black light

Class Arachnida:
Order Scorpiones: Scorpions

Black Thick-Tailed Scorpion, *Parabuthus transvaalicus*, a highly venomous species native to South Africa

Class Arachnida: Order Acari: Ticks

- Ticks have two body regions.
- Young have six legs, adults have eight.
- There are hard and soft-bodied ticks.
- Ticks are much larger than mites, some females as large as a nickel.

Blacklegged Tick, *Ixodes scapularis*

Class Arachnida: Order Acari: Chiggers

Chigger Bites on Human

- Attach to skin using two claws.
- Two blade-like beaks enter the skin.
- Injected fluid dissolves skin tissue around beaks, but hardens surrounding tissue so that a stylostome, or tube is formed.
- Chigger sucks up liquid through stylostome.
- Tube remains after chigger leaves, causing itching.

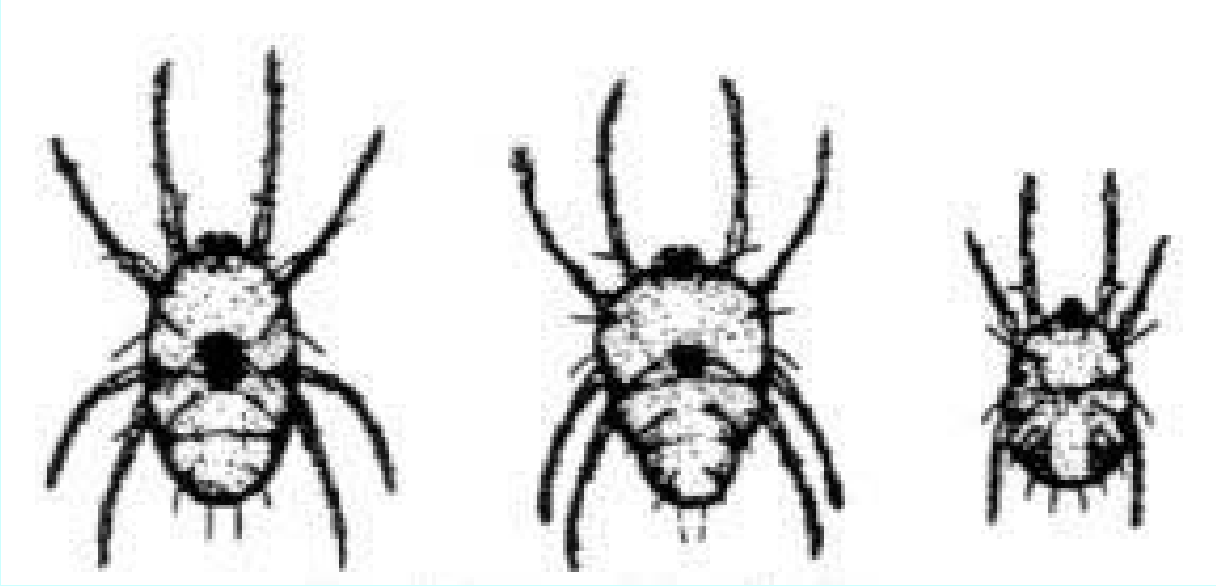
Class Arachnida:
Order Acari: Mites

- Mites have only one noticeable body region.
- Many are microscopic or close to it.

Mites

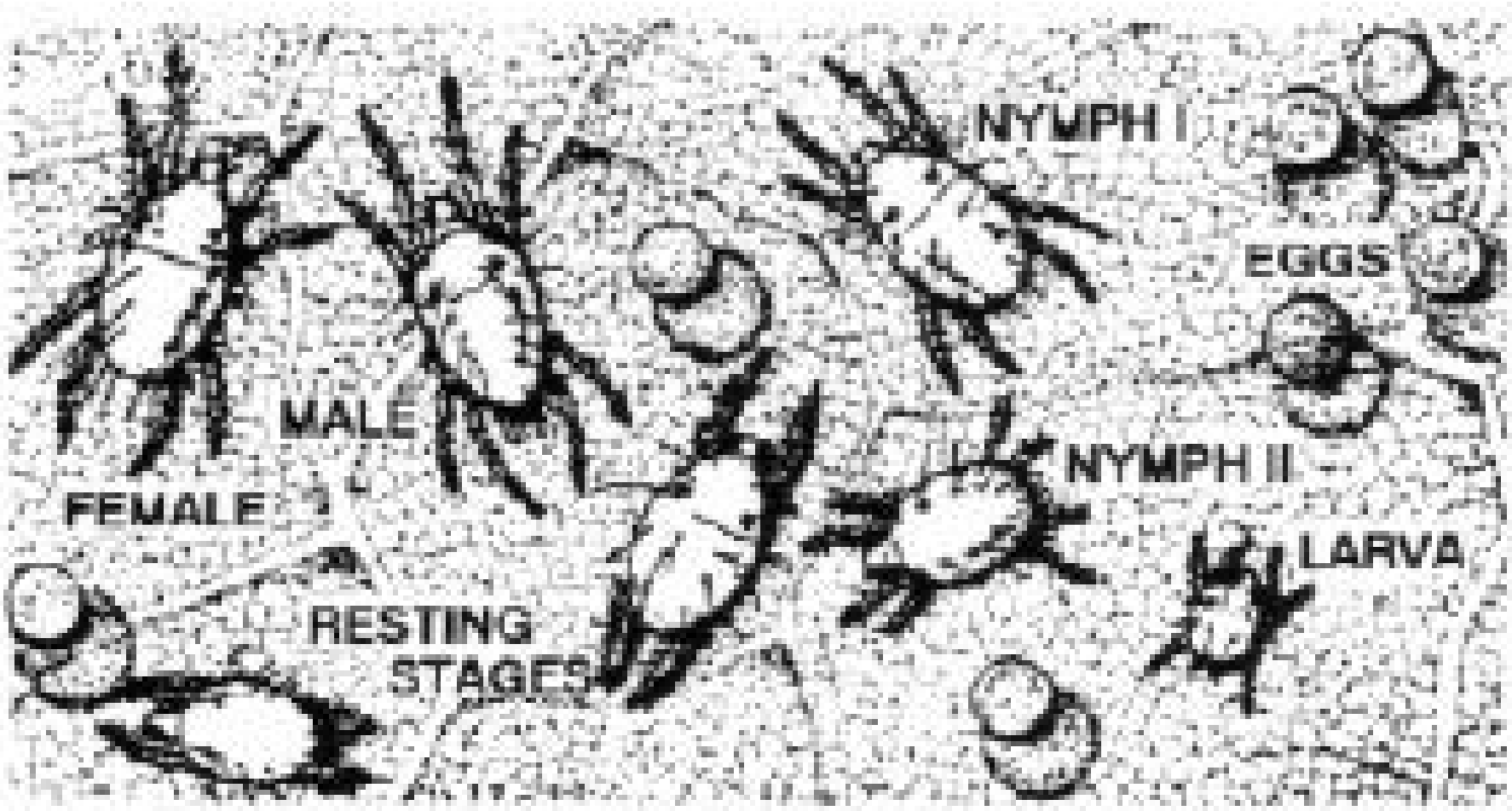
- Egg, larva, protonymph, deutonymph, adult.
- Four pair legs; three pairs on larvae.
- Two body segments: head, thorax.
- Chelicerae: fangs like spiders.
- Suck cells.
- Cause chlorosis; yellowing of foliage.
- Transmit disease.
- Diagnostics: chlorosis, webbing, rusetting, galls.

Mites



- Female: round abdomen
- Male: pointed abdomen
- Larva 3 pairs of legs

Mite Life Cycles



Twospotted Spider Mite Stages

Warm/Cool Season Mites

Warm season

- Twospotted spider mite
- European red mite
- Bulb mite
- Gall, rust mite
- Cyclamen mite

Cool season

- Spruce spider mite
- Clover mite

Twospotted Spider Mite,
Tetranychus urticae

Mites in the Greenhouse

Family Tetranychidae:

- Twospotted spider mite
- Lewis mite

Family Tarsonemidae:

- Cyclamen mite
- Broad mite

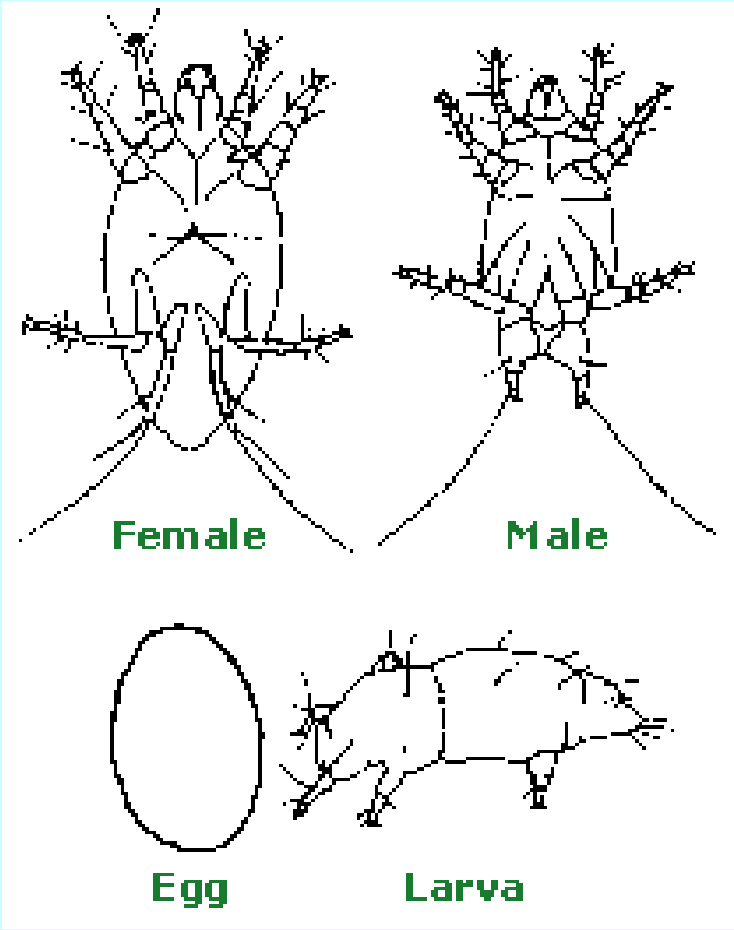
Family Acaridae:

- Bulb mite

Family Eriophyidae:

- Gall, rust mite

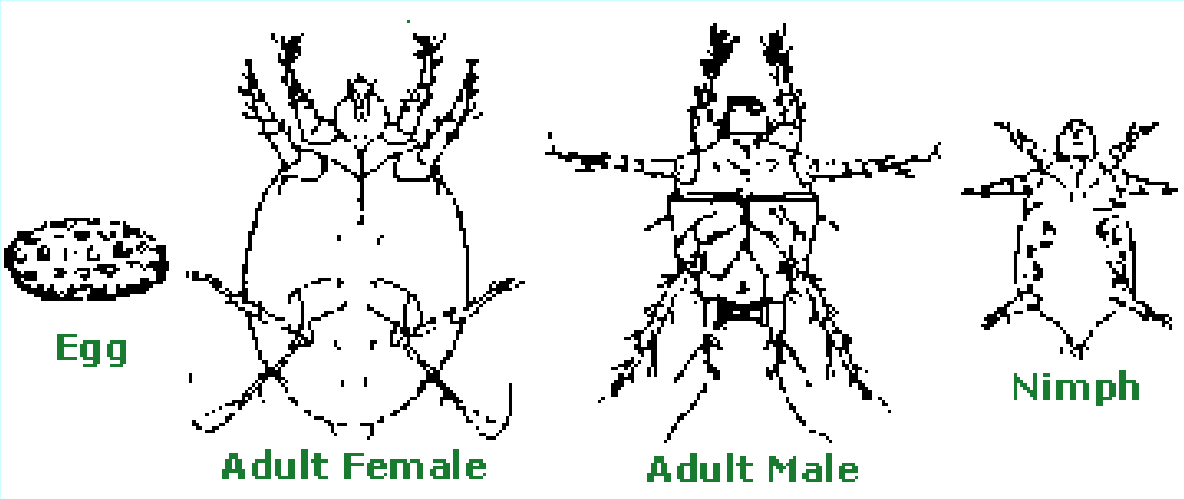
CUES
http://www.entomology.umn.edu/cues/inter/inmine/Mitesc.html



Cyclamen Mite

Mites in the Landscape

- Family Eriophyidae: gall or vagrant mites
- Family Tetranychidae: spider mites
- Family Tarsonemidae: cyclamen/broad mites
- Family Phytoseiidae: predatory mites
- Family Acaridae: bulb mite
- Family Oribatidae: soil mites



Broad Mite

CUES, http://www.entomology.umn.edu/cues/inter/inmine/Mitesc.html

Family Phytoseiidae: Predatory mites

Predatory mites:
Phytoseiulus persimilis

© Photo courtesy
Holt Studios, UK

Family Tetranychidae: Spider mites

Clover Mite, *Bryobia praetiosa*

- Found in turf.
- Long front legs.
- Make webbing in fall.

Epiclass Hexapoda: Insects, springtails, diplurans, proturans

- Three distinct body regions: head, thorax, abdomen.
- One pair antenna.
- One pair of mandibles.
- One pair of maxillae.
- Three pairs of legs on thorax.

Japanese Beetle, *Popillia japonica*

- Tracheal respiratory system- composed of tubes with holes (spiracles) through the body that admit air.

David R. Maddison, Tree of Life Web Project
http://tolweb.org/tree/phylogeny.html

Class Entognatha: Order Diplura: Diplurans

- Ametabolous: simple metamorphosis.
- Two caudal filaments.
- Compound eyes.
- Antennae.
- Wingless adults.
- Difference between nymphs and adults is size.
- Feed on decomposing materials.

Class Entognatha:
Order Collembola: Springtails

- Ametabolous: simple metamorphosis.
- Furcula or fork-like springing structures.
- Simple eyes.
- Antennae.
- Wingless adults.
- Difference between nymphs and adults is size.
- Feed on decomposing materials.

Class Entognatha:
Order Protura: Proturans

- Ametabolous: simple metamorphosis.
- No eyes.
- No antennae.
- Very small.
- Wingless.
- Difference between nymphs and adults is size.
- Feed on decomposing materials.

Class Insecta: Insects

- Protruding mouthparts, unlike non-insect hexapods.
- Ametabolous, hemimetabolous, parametabolus, or holometabolous.
- Most have wings.

Milkweed Leaf Beetle,
Labidomera clivicollis

Class Insecta:
Order Thysanura: Silverfish

- Ametabolous: simple metamorphosis.
- Three tail-like appendages.
- Body flattened and covered with scales.
- Wingless adults.
- Difference between nymphs and adults is size.
- Found in wet places.

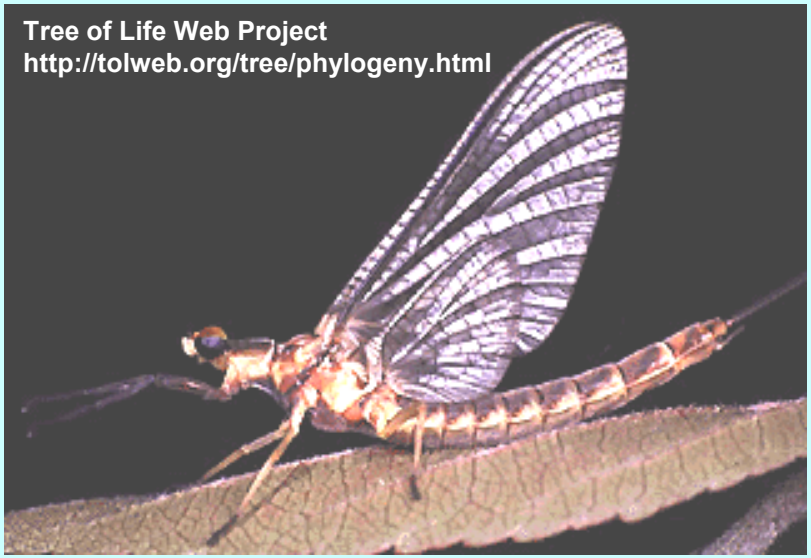
Lepisma saccharina

Class Insecta: Pterygota: Winged Insects

- Most adult forms have wings.
- Hemimetabolous, parametabolus, or holometabolous.

Polyphemus Moth, *Antheraea polyphemus*

Class Insecta:
Order Ephemeroptera:
Mayflies



- Hemimetabolous metamorphosis: simple, incomplete.
- Winged adults live for a day.
- Wings at rest held over body.
- 2-3 caudal filaments.
- Nymphs and adults in different habitat.
- Nymphs and adults different in appearance.
- Aquatic nymphs with gills.
- Indicate good water quality.

Class Insecta:
Order Odonata: Dragonflies and damselflies

- Hemimetabolous metamorphosis: simple, incomplete.
- Toothed mandibles (chewing mouthparts).
- Winged adults.
- Nymphs and adults different in appearance.
- Aquatic nymphs with gills.
- Indicate good water quality.

Damselfly

Class Insecta: Pterygota, Neoptera

- These insects can fold their wings back over the body.
- Hemimetabolous, parametabolus, or holometabolous.

Green Stink Bug, *Acrosternum hilare*

Class Insecta:
Order Plecoptera: Stoneflies

- **Hemimetabolous metamorphosis: simple, incomplete.**
- **Folded wings.**
- **Winged adults.**
- **Chewing mouthparts.**
- **Aquatic, gilled nymphs.**

***Triznaka signata* adult (top),**
***Perlesta decipiens* nymph (bottom)**

Class Insecta: Pterygota, Neoptera: Paurometabolous/ gradual Metamorphosis

- Walkingsticks
- Grasshoppers and crickets
- Mantids
- Cockroaches
- Termites
- Earwigs
- Stoneflies
- Lice
- True Bugs
- Cicadas, hoppers and aphids
- Thrips

Class Insecta:
Order Phasmatodea: Walkingsticks

- Paurametabolous metamorphosis: gradual.
- Winged adults.
- Chewing mouthparts.
- Nymphs and adults in same habitat.
- Nymphs and adults similar in appearance.

Anisomorpha sp.

Class Insecta: Order Orthoptera: Grasshoppers, katydids, and crickets

- Paurametabolous metamorphosis: gradual.
- Straight wings.
- Winged adults.
- Chewing mouthparts.
- Nymphs and adults in same habitat.
- Nymphs and adults similar in appearance.

Redlegged Grasshopper,
Melanoplus femurrubrum

Russ Ottens, The University of Georgia
www.insectimages.org

Class Insecta: Order Mantodea: Mantids

- Paurametabolous metamorphosis: gradual.
- Winged adults.
- Chewing mouthparts.
- Nymphs and adults in same habitat.
- Nymphs and adults similar in appearance.

Clemson University
http://entweb.clemson.edu/cuentres/cesheets/benefici/ce178.htm

Praying Mantis

Class Insecta:
Order Blattaria: Cockroaches

- Paurametabolous metamorphosis: gradual.
- Winged adults.
- Chewing mouthparts.
- Nymphs and adults in same habitat.
- Nymphs and adults similar in appearance.

American Cockroach,
Periplaneta americana

Class Insecta:
Order Isoptera: Termites

- Paurametabolous metamorphosis: gradual.
- Equal wings.
- Winged adults.
- Chewing mouthparts.
- Nymphs and adults in same habitat.
- Nymphs and adults similar in appearance.

Formosan Subterranean Termite,
Coptotermes formosanus

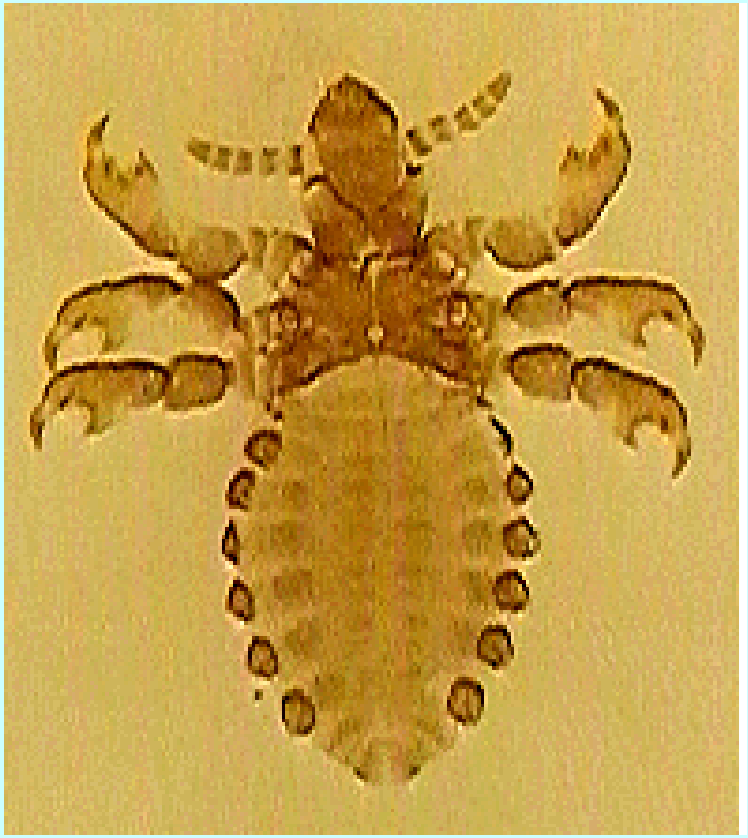
Class Insecta:
Order Dermaptera: Earwigs

- Paurametabolous metamorphosis: gradual.
- Skin-like front wings.
- Winged adults.
- Chewing mouthparts.
- Nymphs and adults in same habitat.
- Nymphs and adults similar in appearance.

Striped Earwig,
Labidura riparia

Class Insecta: Order Phthiraptera (Mallophaga and Anoplura): Lice

- **Paurametabolous metamorphosis: gradual.**
- **Wingless adults.**
- **Chewing or sucking mouthparts.**
- **Nymphs and adults in same habitat.**
- **Nymphs and adults similar in appearance.**



Iowa State University"s Entomology Image Gallery

Sucking Louse,
Haematopinus eurysternus

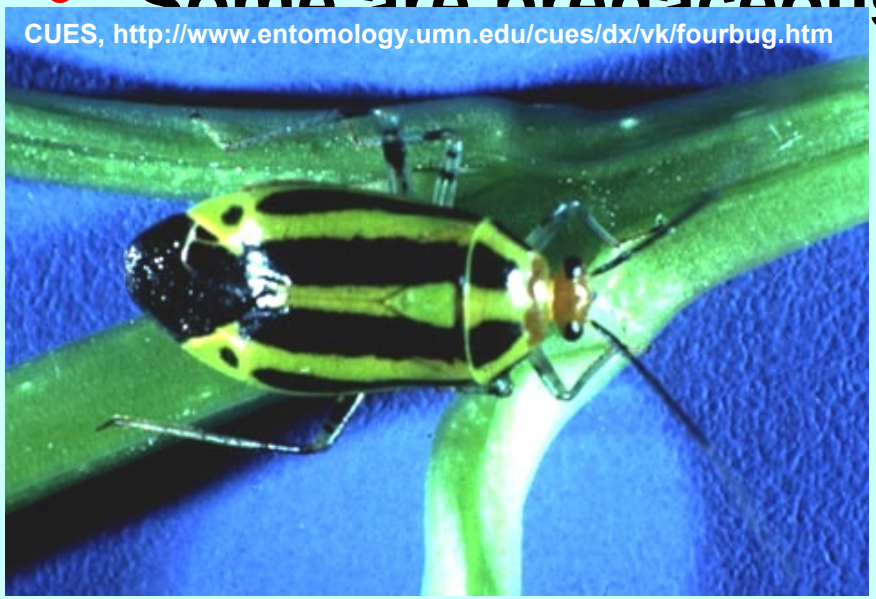
Class Insecta: Order Hemiptera:

Suborder Heteroptera: True bugs
Suborder Sternorrhyncha: Aphids, whiteflies, scales
Suborder Auchenorrhyncha: Cicadas, hoppers

- **Paurametabolous metamorphosis: gradual.**
- **Usually winged adults.**
- **Sucking mouthparts.**
- **Nymphs and adults in same habitat.**
- **Nymphs and adults similar in appearance.**
- **Sternorrhyncha and Auchenorrhyncha used to be classified in Order Homoptera.**

Class Insecta: Order Hemiptera: Suborder Heteroptera: True bugs

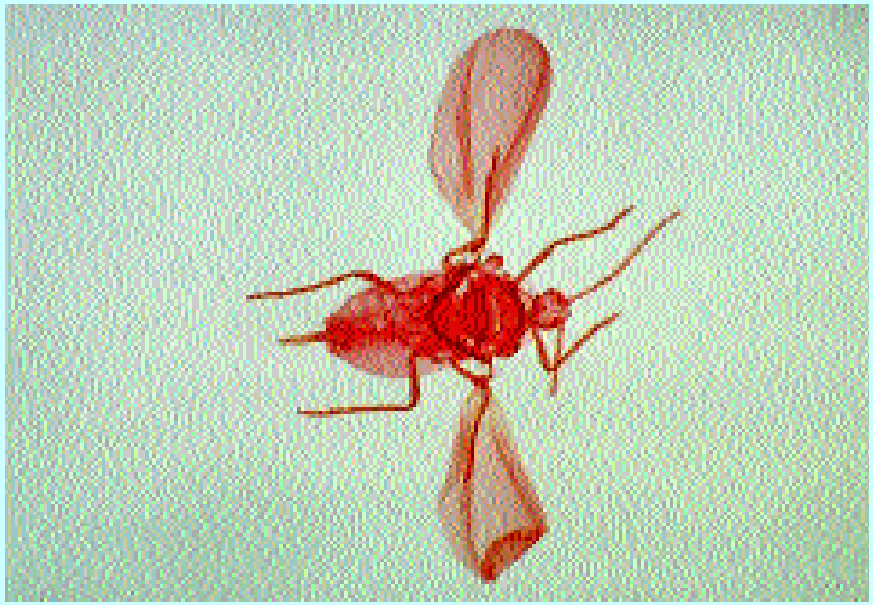
- Most bugs feed on plants.
- Some are predaceous.



Fourlined Plant Bug,
Poecilocapsus lineatus

Predaceous Stink Bug attacking caterpillar

Order Hemiptera: Suborder Sternorrhyncha Soft Scale (formerly in Order Homoptera)



Summer Male

Summer Female and Crawlers

Tuliptree Scale,
***Toumeyella liriodendri*: Linden, walnut**

Order Hemiptera: Suborder Sternorrhyncha
Armored Scale (formerly in Order Homoptera)

Clemson University - USDA Cooperative Extension Slide Series, www.insectimages.org

Euonymus Scale, *Unaspis euonymi*

Order Hemiptera: Suborder Auchenorhyncha
Cicadas, hoppers (formerly Order Homoptera)

Spittlebug

Leafhopper

Class Insecta: Order Thysanoptera: Thrips

- Paurametabolous metamorphosis: gradual.
- Fringe-winged.
- Winged adults.
- Nymphs and adults in same habitat.
- Nymphs and adults similar in appearance.

Onion Thrips, *Thrips tabaci*

Class Insecta: Pterygota, Neoptera, Endopterygota: Holometabolous/ complete metamorphosis

- Lacewings
- Beetles
- Scorpionflies
- Fleas
- Flies
- Caddisflies
- Moths and butterflies
- Sawflies, wasps, and bees

Herbert A. "Joe" Pase III, Texas Forest Service, www.insectimages.org

Forest Tent Caterpillars, *Malacosoma disstria*

Class Insecta: Order Neuroptera: Lacewings, antlions, owlflies

Green Lacewing, *Chrysoperla* sp., Adult (left) and Larva (right)

Class Insecta: Order Neuroptera: Lacewings, antlions, owlflies

- Holometabolous metamorphosis: complete.
- Nerve-winged.
- Winged adults.
- Chewing mouthparts.
- Larvae and adults sometimes in same habitat.
- Some larvae are aquatic.
- Larvae and adults not similar in appearance.

Class Insecta:
Order Coleoptera: Beetles

Japanese Beetle,
***Popillia japonica*, Adult (left)**
and Scarab Larva (below)

Class Insecta:
Order Coleoptera: Beetles

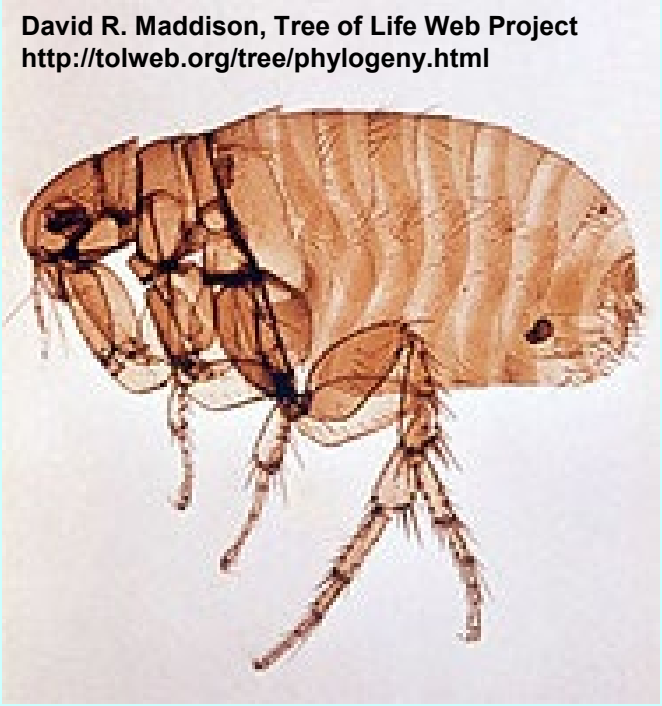
- Holometabolous metamorphosis: complete.
- Hardened forewings (elytra).
- Winged adults.
- Chewing mouthparts.
- Larvae and adults in same habitat.
- Larvae and adults not similar in appearance.

Class Insecta:
Order Mecoptera: Scorpionflies

- Holometabolous metamorphosis: complete.
- Long wings.
- Winged adults.
- Larvae and pupae sometimes found in soil.
- Larvae and adults not similar in appearance.

Class Insecta:
Order Siphonoptera: Fleas

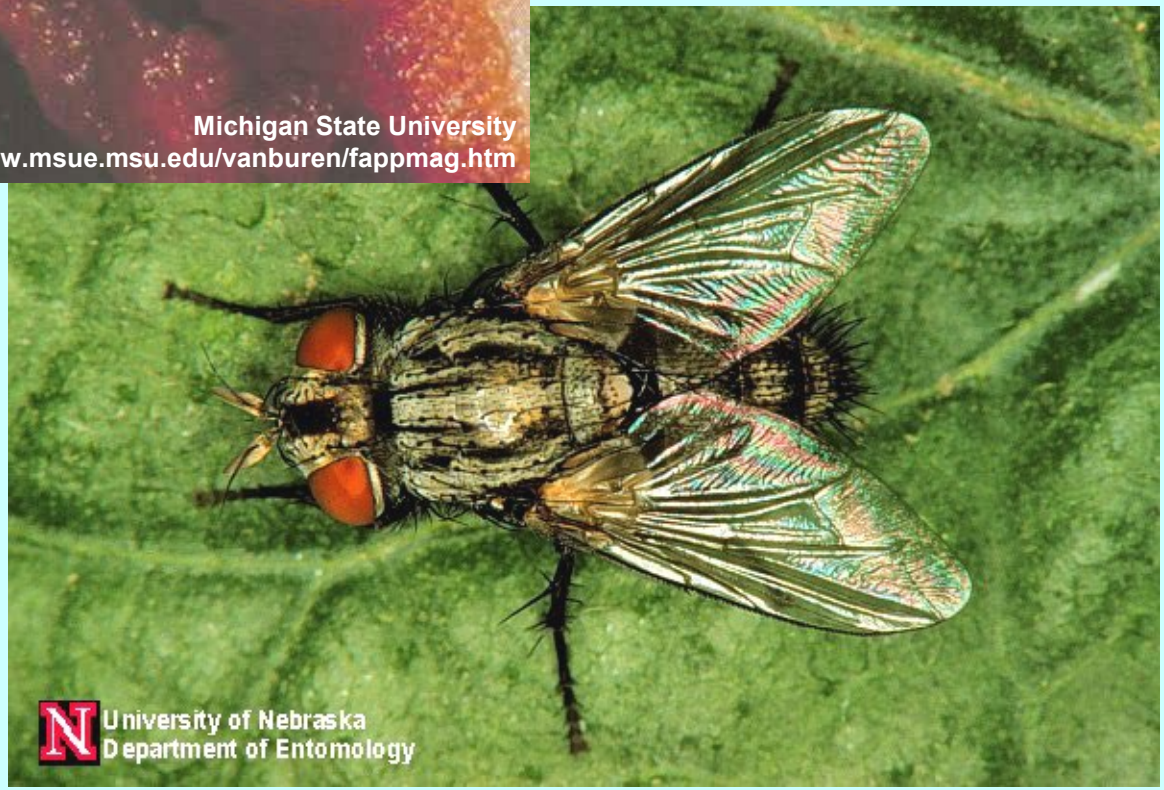
- Holometabolous metamorphosis: complete.
- Wingless adults.
- Sucking mouthparts.
- Larvae and adults not similar in appearance.
- Often pests of mammals.



Oriental Rat Flea,
Xenopsylla cheopis

Class Insecta:
Order Diptera: Flies

Fly Larva (maggot)



Tachinid Fly Adult

Class Insecta:
Order Diptera: Flies

- Holometabolous metamorphosis: complete.
- Winged adults.
- 2nd pair of wings are halteres.
- Larvae and adults often in same habitat.
- Larvae and adults not similar in appearance.
- Some spread diseases to humans and livestock.
- Some are parasitoids.

Class Insecta:
Order Trichoptera: Caddisflies

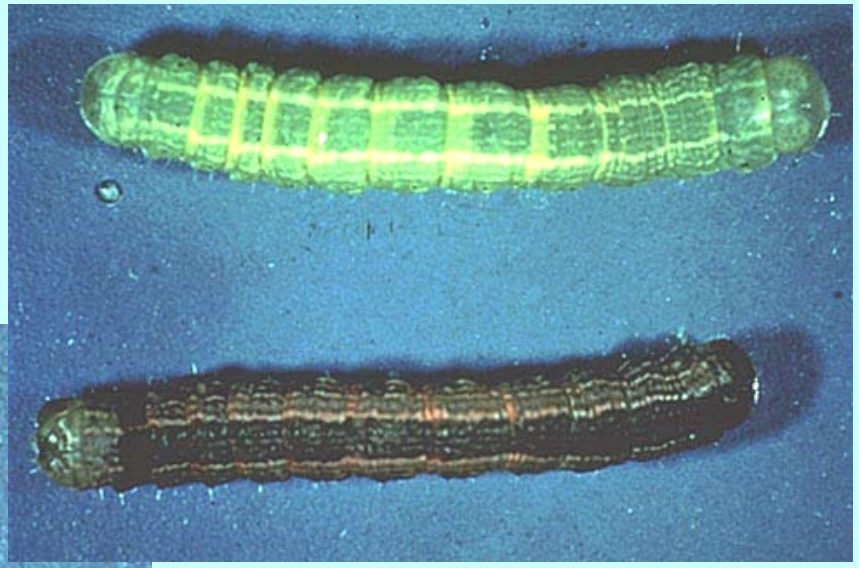
- Holometabolous metamorphosis: complete.
- Winged adults.
- Aquatic larvae construct and live in tubes.
- Larvae and adults not similar in appearance.
- Indicators of water quality.

Tree of Life
http://tolweb.org/tree/phylogeny.html

Caddisfly Adult (top) and Larvae (bottom)

Class Insecta:
Order Lepidoptera: Moths and butterflies

Cankerworm Larvae (right) and Adult (below)



CUES
http://www.entomology.umn.edu/cues/dx/vk/canker.htm

Class Insecta:
Order Lepidoptera: Moths and butterflies

- **Holometabolous metamorphosis: complete.**
- **Winged adults.**
- **Larvae and adults not similar in appearance.**
- **Most larvae feed on plant tissue.**
- **Many moths are pests; most butterflies are not.**

Class Insecta:
Order Hymenoptera: Sawflies, wasps, bees, ants

CUES, http://www.entomology.umn.edu/cues/dx/sk/pine11.htm

Introduced Pine Sawfly, *Diprion similis*, Adults (left) and Larva (right)

Class Insecta:
Order Hymenoptera: Sawflies, wasps, bees, ants

- Holometabolous metamorphosis: complete.
- Membranous wings.
- Winged adults.
- Larvae and adults not similar in appearance.
- Sawflies are phytophagous.
- Some wasps are parasitoids.
- Many wasps, bees, and all ants are social.