




Oregon State UNIVERSITY **OSU**

Organic Gardening Certificate Program

Entomology

Quiz: Insect? Yes or No

- Segmented bodies
- No legs
- Appendages in the head (jaws, feelers, etc.)

Image Source: <http://trc.ucdavis.edu/biosd10/vbis10/week9/07annelids.html>

Quiz: Insect? Yes or No

- Two distinct body divisions
- 4 pair of legs
- No antennae


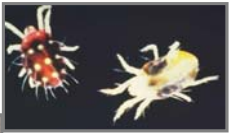
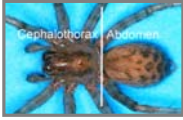




Photo Images Courtesy of: Dept. of Entomology, University of Nebraska-Lincoln

Major Classes of Arthropods Class Arachnida: Order Araneida (Common Name: Spiders)

- Two distinct body divisions, 4 pair legs
- First pair of appendages are chelicerae
- All possess venom glands and spinnerets
- Pedipalps in male are modified for sperm delivery

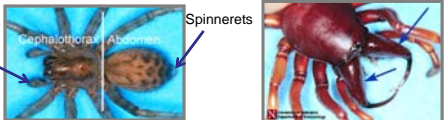
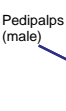
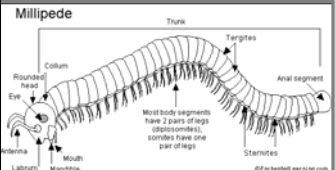




Photo Images Courtesy of: Dept. of Entomology, University of Nebraska-Lincoln

Quiz: Insect? Yes or No

- Worm-like and cylindrical
- Two pair of legs per body segment
- All are detritivores
- Some iodine like liquid or cyanide as a chemical defense

Quiz: Insect? Yes or No

- Worm-like and flattened
- One pair of legs per body segment
- First pair of legs is modified into poison claws (fangs)
- Predaceous on insects and other small arthropods




Objective

- You will NOT be able to identify insects from this class.
- You should:
 - Have a greater appreciation for insects
 - Have a few generalized rules for identifying insect types
 - Have a better understanding of the role of insects in the garden

Introduction to Entomology

Insect External Anatomy

Characteristics of Class Insecta

Insect External Anatomy Head

- Mouthparts (paired mandibles, maxillae and labium)

Md = mandibles
Lr=labrum
Mx=maxillae
Lb=labium

Image Source: <http://www.answers.com/topic/evolution-insect-mouthparts-png>

Insect External Anatomy Thorax

- Pro-, meso- and meta-thorax
 - Each segment bears a pair of legs
 - Meso- and meta-thorax each bear a pair of wings

Image Source: <http://bugs.bio.usyd.edu.au/Entomology/images/Topics/extMorphology/thoraxComponents.gif>


Insect External Anatomy Abdomen

- Reproductive appendages
 - Ovipositor in females
 - Penis / aedeagus in males
- Cerci


Introduction to Entomology

General ID Rules


Which one is NOT a plant-feeder?



Which one is NOT a plant-feeder?




Which one is NOT a plant-feeder?



You are likely to be a plant feeder if:
You try and hide from predators!



You are likely to be a plant feeder if:
You try and hide from predators!



You are likely to be a plant feeder if:
You're a poser!

- Swallowtail larvae: wave back and forth upon disturbance



You are likely to be a plant feeder if:
You advertise that you taste bad!



You are likely to be a plant feeder if:
You advertise that you taste bad!



Generalist plant feeders.





Parasitoid Wasps

 Four photographs of parasitoid wasps. Top-left: A braconid wasp emerging from a moth cocoon. Top-right: An ichneumonid wasp on a human hand. Bottom-left: Braconid pupae on a tomato hornworm. Bottom-right: An ichneumonid wasp on a leaf.

Image Source: AMNH

Parasitoid Wasps

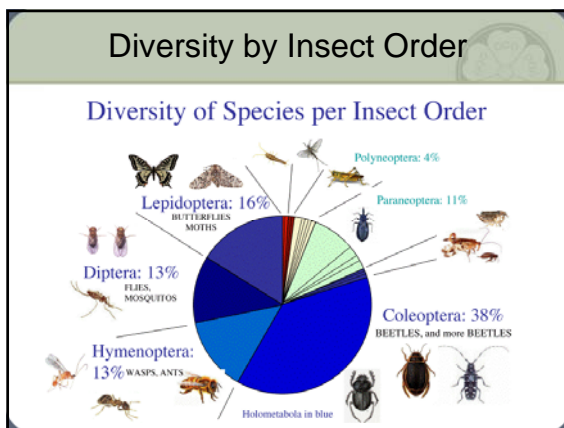
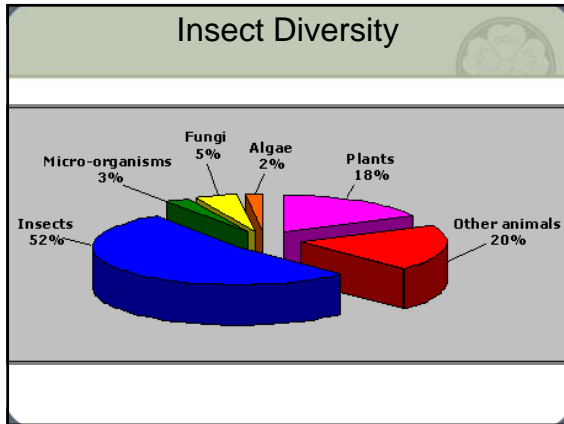
 Four photographs of parasitoid wasps. Top-left: A brown eulophid wasp. Top-right: A blue pteromalid wasp. Bottom-left: A green aphelenid wasp. Bottom-right: A small encyrtid wasp on a green leaf.

Parasitized Insects

 Four photographs of parasitized insects. Top-left: Aphid mummies on a leaf. Top-right: Parasitized cabbage moth larvae on a leaf. Bottom-left: A parasitoid emerging from an aphid mummy. Bottom-right: Parasitized beetle larvae on a leaf.

Introduction to Entomology

Insect Diversity and Life Cycles



Ametabolous Development

- Juveniles resemble adults, except that they are smaller
- With each molt, abdominal segments are added

Ametabolous Development

Egg Young Adult

Hemimetabolous Development

- Juveniles (called nymphs) resemble adults, except that they are smaller, and do not have wings
 - Development of wing buds or wing pads in later stages
- With each molt, wing buds get larger

Hemimetabolous Development

Egg Nymph Adult

Holometabolous Development

- Juveniles (called larvae) look quite different from adults
 - Worm like
 - Grub like
 - Caterpillar like
- Pupal stage, where metamorphosis occurs
- Larval and adult stages often feed on very different things and/or live in very different habitats

Holometabolous Development


Egg Larvae Pupa Adult

Insect Life Cycles

- Juveniles
 - Not winged / can't fly
 - Not sexually mature


- Adults
 - Winged / can fly
 - Sexually mature

Monarch Butterfly Larva




No Wings

Monarch Butterfly




Wings

Potato Leafhopper Nymph



Wing Pads

Potato Leafhopper Adult







Wings

Image Sources:
 (Lepidoptera: <http://www.museum.vic.gov.au/bugs/ifa/butterflies.aspx>)
 (Hemiptera: <http://www.gom.uiluc.edu/cropsc27/13/sylabus/images/0207/image13.jpg>)

Common Insect Orders

- 31 Insect Orders
 - Most recent discovery in 2002! (Mantophasmatodea)
- Orders of particular interest to gardeners include:
 - Coleoptera, Dermaptera, Diptera, Hemiptera, Hymenoptera, Lepidoptera, Neuroptera, Orthoptera, Thysanoptera
- '-ptera' means 'wing' (think Pteradactyl)
 - To ID almost all insects to order, you should look at the wings of the adults
 - Juvenile IDs are much more difficult

Lepidoptera = 'Scale Wing'

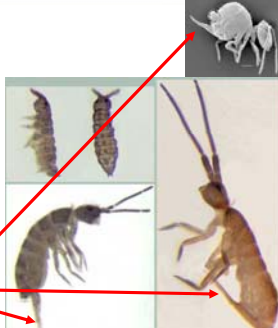
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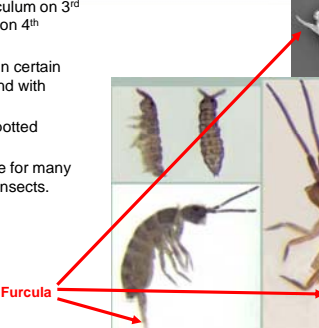
Ametabolous Insects

Collembola

- Abdomen has retinaculum on 3rd segment and furcula on 4th segment
- Extremely abundant in certain soil habitats (moist and with much organic debris)
- Occasional pests in potted plants, greenhouses.
- Important food source for many arachnids and other insects.





Furcula



Thysanura (silverfish, bristletails)

- Ametabolous, no wings
- Antennae very long
- Well-developed eyes
- Abdomen with 11 segments, 3 bristly cerci
- Mating rituals.
- Habitats include moist, shady locations outside and hot, dry locations indoors.
- Feed on starchy substances. Can be indoor pests on wallpaper, books, cereals.

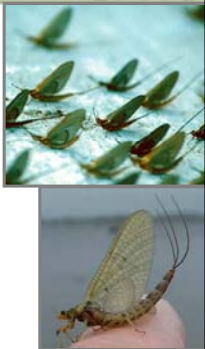
Introduction to Entomology

Hemimetabolous Insects

Ephemeroptera = "Short Lived Wings"

Adult Characteristics


- Mayflies
- Adults are short lived (Vestigial mouthparts)
- Fragile bodies. Weak legs.
- Body curved upward at the head and tip of the abdomen, when at rest.
- Three caudal filaments at the end of the abdomen.
- Adult swarms can be a nuisance
- Important part of freshwater food chains.



Orthoptera = "Straight Wing"

Grasshoppers, katydids, crickets


- Two pair of wings. First pair is a leathery tegmina. Second pair is membranous and fanlike.
- Chewing mouthparts.
- Some are extremely destructive pests to cultivated crops
- Can be found in a variety of habitats – old fields, woodland, households



Odonata = "Tooth Wing"

Adult Characteristics

- Dragonflies and damselflies
- Long, thin abdomen.
- Adults have 2 pair of membranous, elongate wings, with many crossveins.
- Chewing mouthparts.
- Dragonflies hold wings horizontal, at rest. Damselfly wings are folded over abdomen, upright, when at rest.
- Adults patrol over streams, ponds, and other freshwater aquatic habitats.
- All are predaceous.



Orthoptera = "Straight Wing"

Grasshoppers, katydids, crickets

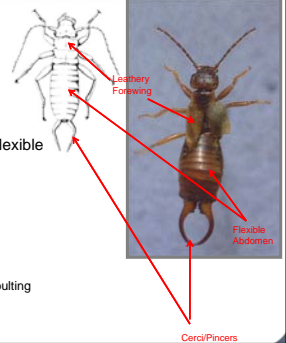
- Two pair of wings. First pair is a leathery tegmina. Second pair is membranous and fanlike.
- Chewing mouthparts.
- Some are extremely destructive pests to cultivated crops
- Can be found in a variety of habitats – old fields, woodland, households



Dermaptera = "Skin Wing"


Earwigs

- Two pairs of wings
 - Forewings short, square and veinless
 - Hindwings fanlike
- Abdomen is uncovered and very flexible
- Cerci form pincers
- Biting mouthparts
 - Scavenge plant and animal matter
 - Can petal feed on ornamental plants
- Color
 - Pale brown to black,
 - Temporarily white and cream after moulting




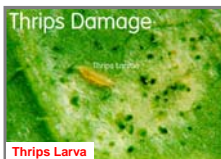

Isoptera = "Same Wing" Termites

- Two pair of wings. Few cross veins. Wings longer than body.
- Eusocial.
 - Reproductive division of labor. Castes. Cooperative care of young.
- Only reproductive caste has wings, and only near the time of nuptial flight.
- Live in ground or in wood.
- Many are pests of buildings. Most are beneficial, because they recycle nutrients from dead trees and other plant materials.



Thysanoptera = "Fringe Wings" Thrips

- 2 pairs of tiny, feather-like wings
- Small → 0.5 - 15mm long
- Mouthparts adapted for piercing and are highly asymmetric
- Color: Yellow, brown or black
- Very narrow body
- Prominent compound eyes

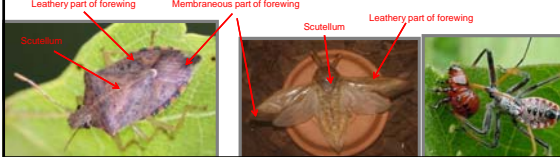
Hemiptera = "Half Wing"

- 2 pairs of wings (some species wingless)
 - Forewings generally hardened to some extent
- 1mm - 100mm long
- Mouthparts suctorial and developed for piercing
 - Cibarial pump
 - Most vegetarian or omnivorous
 - Some strictly carnivorous species
- Most are terrestrial. A few families are aquatic.

Hemiptera = "Half Wing"

Suborder Heteroptera

- Two sets of wings: Wings folded flat over the body at rest
- Forewings divided into two regions of different textures
- Hindwings membranous and held under forewings, at rest
- Scutellum (triangle) on thorax
- Head projects horizontally and is visible from above
- Piercing/Sucking Mouthparts



Hemiptera = "Half Wing"

Suborder Homoptera

- Two sets of wings
 - Forewings are of uniform texture (all membranous or leathery)
 - Hindwings are membranous
 - Wings are held like a roof over the back
- Piercing/Sucking Mouthparts



Hemiptera = "Half Wing"

Suborder Homoptera



Introduction to Entomology

Holometabolous Insects

Coleoptera = "sheath wing" Beetles

- Two pairs of wings
 - Forewings (elytra) are veinless, toughened and hard, covering the entire abdomen and meeting at the midline
 - Hindwings are membranous
- Prothorax is large, and covered by the pronotum
- Chewing mouthparts
- Distribution
 - More than 300,000 species
 - World-wide
 - Habitats: from deserts to tropical regions, mainly ground dwelling and in vegetation, some aquatic
 - Feed on most solids, including crops, timber and dry bone

Oregon Beetles

Banded Alder Borer

Striped Cucumber Beetle

Asian Ladybug Beetle
Pupa (left) and adult (right)

10 Lined June Beetle

Black Vine Weevil

Neuroptera = 'Nerve Wing' Antlions, Owlflies, Lacewings

- Two pairs of membranous wings
 - Dense network of cross veins on wings
 - Prominent vein forks at wing margins
- Holometabolous Development
- Chewing mouthparts
 - Predators of smaller insects and pollen-eaters
- Distribution
 - 6,000 species
 - World-wide, although families are more restricted
 - Vegetation, ground debris, in woodlands, sandy soils

Antlion Larval Pits

Antlion Larva

Antlion Adult

Neuroptera = 'Nerve Wing' Lacewings

Megaloptera = 'Big Wing' Alderflies and Dobson flies

- Two pairs of membranous wings
 - Many veins and cross veins (forming a nerve network)
 - Hindwing a bit wider at base than forewing
- Chewing mouthparts
- Prognathous head with large mandibles (sexually dimorphic)
- Larvae of Dobsonflies (hellgramites) are often used as fish bait.





Male Dobson Fly

Hellgramite

Female Dobson Fly



Lepidoptera = 'Scale Wing'

- Two pairs of scale colored wings
- Mouthparts mainly suctorial, with proboscis
 - Feed on liquids, usually nectar.
 - Mud-puddling behavior
 - Some drink tears, urine, and even blood
- Distribution
 - 20,000 species
 - Associated with plants, especially angiosperms







Siphonaptera = 'No Wing' Fleas

- Wingless
- Piercing, sucking mouthparts
 - (obligate blood feeders)
- Laterally flattened
- Hindlegs adapted for jumping
- Pronotal comb





Hymenoptera = 'Membraneous Wing'

- Two pairs of membranous wings
 - Hindwings much smaller than forewings
 - Hindwings hook to forewings with hanuli
- Biting mouthparts (except bees)
 - Predators, herbivores and nectar feeders
- Distribution
 - Over 100,000 species
 - Habitats: from woodland to desert














Hymenoptera = 'Membraneous Wing'

- Suborder Symphyta
 - No typical wasp-waist
 - Hold wings flat over the body
- Suborder Apocrita
 - Wasp-waist
 - Have wingless castes
 - Divided into two groups, the Parasitica and Aculeata (Social wasps)

Bees

Parasitoid Wasps





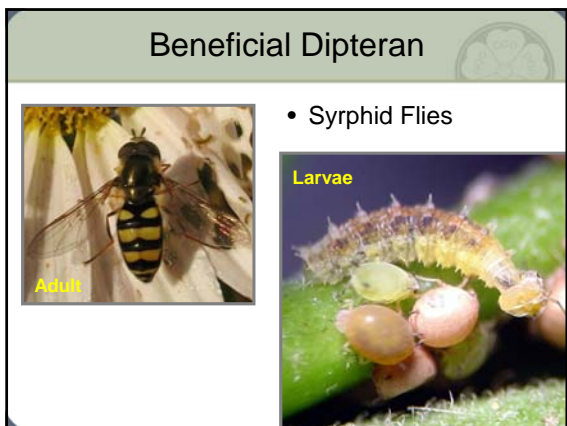
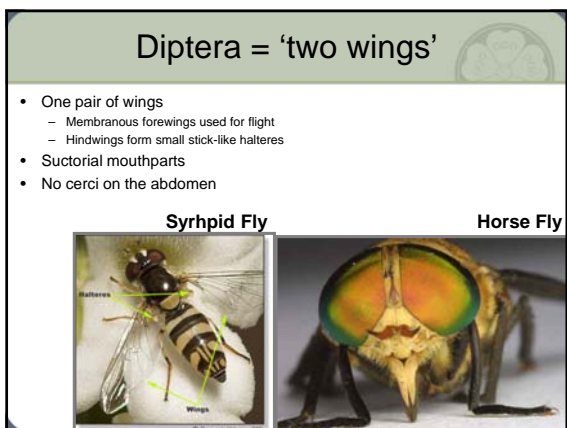
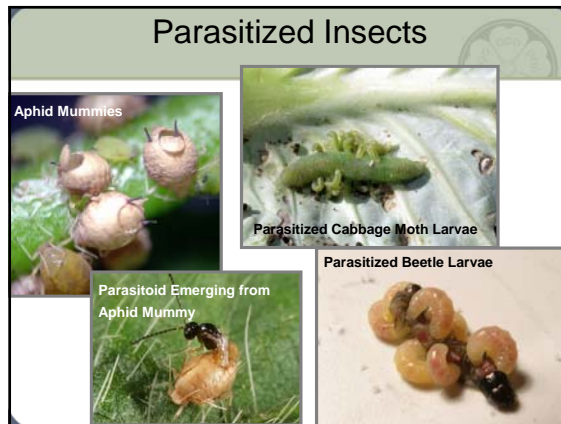
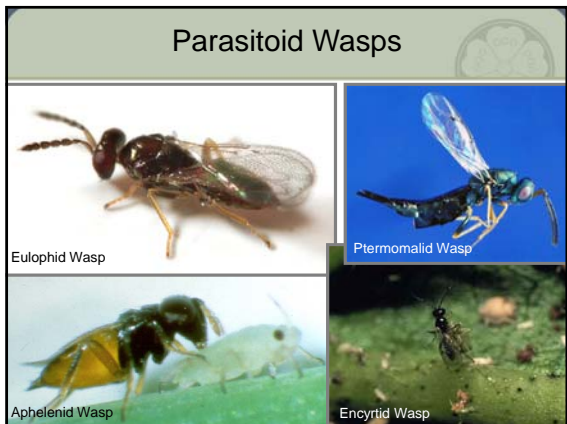





Image Source: AMNH



Introduction to Entomology

Diagnosing Insect Problems

Diagnosing Insect Problems

- Do not, if at all possible, diagnose a pest problem from a photo
 - Get a sample of the "insect"
 - Get a sample of the damage
- Make sure that the organism is indeed an insect
 - Is it an adult or a juvenile?
- Identify the insect to order (easier to do for adults than for juveniles)
 - What do the wings look like? Are they membraneous? Are there 2 pair? What about cross veins? Are the wings held flat over the body, or tent like over the body?
 - Do the mouthparts of the insect match up with the type of damage being reported?

Step by Step Method of Diagnosis

- Define the problem.
- Look for patterns.
- Observe where the damage occurs on a plant.
- Examine spread of problem.
- Determine likely cause of damage.

Damage by Boring Insects

Carpenter bee nest cells

carpenter bee in its nest

Sawdust is a Sign of carpenter bees

Carpenter bees

Damage by Boring Insects

- Powderpost beetles

larva

Damage by Mining Insects

Miners

Pear slug damage

Pear slug

Boxwood Leaf Miner

Boxwood Leaf Miner Damage

Boxwood Leaf Miner

Damage by Chewing Insects

Chewers

Flea Beetle Larvae and Damage

Black Vine Weevil Damage

Cucumber Beetle & Damage

