The Wonderful World of Insects

James A. Bethke
University of California Cooperative Extension
Farm Advisor Floriculture and Nursery
San Diego County
Taxonomy
The Insects
The Orders
Part I

Taxonomy

Scientific classification or biological classification is a method by which biologists group and categorize species of organisms.
Etymology of Entomology

Entomon from the Greek meaning notched (animals), insects < entomos, cut, notched
- insecare is Latin for 'to cut in'
  (Insect)
- ology from the Greek meaning "Study of"
Animal Kingdom

Invertebrates (Phyla)
1. Porifera - sponges
2. Cnidaria - jellyfish, corals
3. Platyhelminthes - flatworms, flukes, and tapeworms
4. Nemata - roundworms, Trichina, filaria
5. Mollusca - snails, slugs, clams, and oysters
6. Echinodermata - starfish, sea cucumbers; sea urchin
7. Annelida - segmented worms, leeches, earthworms
8. Arthropoda - insects, spiders, crayfish, millipedes

Vertebrates (Phylum)
9. Chordata - fishes, amphibians, reptiles, birds, and mammals
Phylum Arthropoda

Arthropoda (Classes)

insects, spiders, crayfish, millipedes

body composed of ring like segments, jointed appendages, exoskeleton, bilateral symmetry, ventral nerve cord, dorsal heart.
Classification of the common housefly:

Kingdom Animal
Phylum Arthropoda
Class Insecta
Subclass Pterygota
Division Endopterygota
Order Diptera
Family Muscidae
Genus Musca
Species domestica
Author (Linnaeus)

Scientific name = *Musca domestica* (L.)
What Makes a Bug a Bug?

Three very important characteristics separate insects from all other arthropods and animals.

Six legs

Three body parts

Wings
Insects (Class Insecta) are a major group of arthropods and the most diverse group of animals on the Earth, with over a million described species—more than double the number of all other living organisms combined.
Successful Taxa

The most abundant in numbers of species
3/4 of all animals are insects >1/2 of all living organisms are insects

Largest group are the beetles followed by butterflies and moths; wasps, ants, & bees; flies; true bugs (more species of bees than mammals)

Number of species is only an estimate since many are still not named
- 800,000 to 1 million to 30 million

Enormous diversity and found in most environments
Successful Taxa

[Diagram showing various taxa and their relationships, including Mammalia, Porifera, Coelenterata, Platyhelminthes, Nematoda, Annelida, Echinodermata, Protozoa, Chordata, Diptera, flies, mosquitoes, Hymenoptera, ants, bees, Lepidoptera, butterflies, moths, Coleoptera, beetles, and other insects.]
WHY ARE THEY HERE?

Important elements in ecosystems
plant feeders, predators, decomposers, pollinators, vectors of disease, forensic entomology

A world without insects?
Why are insects so abundant and so diverse?

- Small size
- High reproductive potential
- Short generation time
- Resistance to environmental extremes
  (dormancy = diapause, aestivation)
- Readily adapt to changing conditions
- Dispersal via flight
Bugs are involved in every part of your life

**Directly** - food, nuisance, bites, stings

Urban Entomology, Medical Entomology

**Indirectly** - food prices, pollination, crop pests, medical advances, genetics

Agricultural Entomology, Biological Control, Invasive Species
Insecticide Resistance
Look at all those worlds out there, dad... what world do we live in?  

THE INSECT WORLD

"Think about it, Ed. The class Insecta contains 25 orders, almost 1,000 families, and over 750,000 described species — but I can’t shake the feeling we’re all just a bunch of bugs."
Form
Metamorphosis

- Insects, like all arthropods, have to shed their skin to grow.

- Two Types of metamorphosis
  - Complete (Holometabolous)
    - Egg, larva (grub, caterpillar), pupa, adult
  - Incomplete (Hemimetabolous)
    - Nymph (naiad), adult
INSECT METAMORPHOSIS

Most insects undergo a noticeable change in form as they mature, a process known as metamorphosis. Nearly all display either hemimetabolous (incomplete) or holometabolous (complete) metamorphosis. Some insects, however, change so little from birth to adulthood that they are said to have ammetabolous metamorphosis, meaning that there is almost no change aside from an increase in size.

AMETABOLOUS
Insects such as beetles and crickets undergo little change from hatching from their eggs to reaching sexual maturity. Only an increase in size and slight proportional changes occur.

HEMIMETABOLOUS
Insects such as grasshoppers and crickets, where the next stage of development occurs from the same type of egg as the adult stage. There is little change from one immature stage to the next.

HOLOMETABOLOUS
Insects such as butterflies, moths, bees, ants, and wasps, where the immature stages of their development are unlike the adult stage. Each stage has a completely different form to the adult form and goes through a pupal stage before emerging as a fully developed adult.
Mimic
Crypsis
Crypsis
Part III
Orders

29-31 Orders depending upon the scientist
Hymenoptera
Collembola (springtails)
Thysanura (silverfish)
Ephemeroptera (mayflies)
Odonata (dragonflies)
Orthoptera (grasshoppers)
Phasmatoidea (walkingsticks)
Dermaptera (earwigs)
Isoptera (termites)
Blattodea (cockroaches)
Mantodea (mantids)
Zoraptera (zorapterans)
Plecoptera (stoneflies)
Embioptera (webspinners)
Thysanoptera (thrips)
Hemiptera (true bugs)
Homoptera (aphids, etc.)
Phthiraptera (lice)

Biting lice

Chewing lice
Coleoptera (beetles)
Tricoptera (caddisflies)
Siphonaptera (fleas)
Diptera (flies)
Mecoptera (scorpionflies)
Raphidioptera (snakeflies)
Megaloptera (Dobsonflies)
Psocoptera (psocids)
Neuroptera (lacewings, etc.)
Strepsiptera (twisted wing)
Grylloblatodea (rock crawler)
Lepidoptera (butterflies)