Importance of Taxonomic Collections

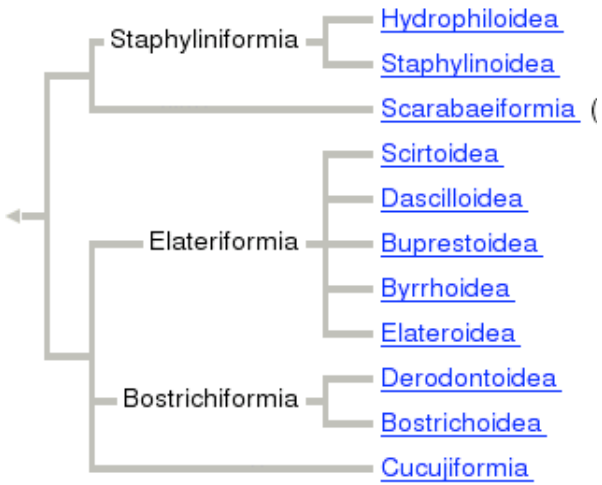
- Document earth's biodiversity
- Facilitate the process of researching relationships among and within different groups of organisms
- Study ecological processes using special collections such as the ant guest collection at UConn
- Safe storage of historical material such as fossils
- Aid in identification of organisms through comparison
- Teaching/Public Outreach: stimulate interest in earth's biodiversity

Importance of Taxonomic Collections c'ont

Definition of some terms you will see often…

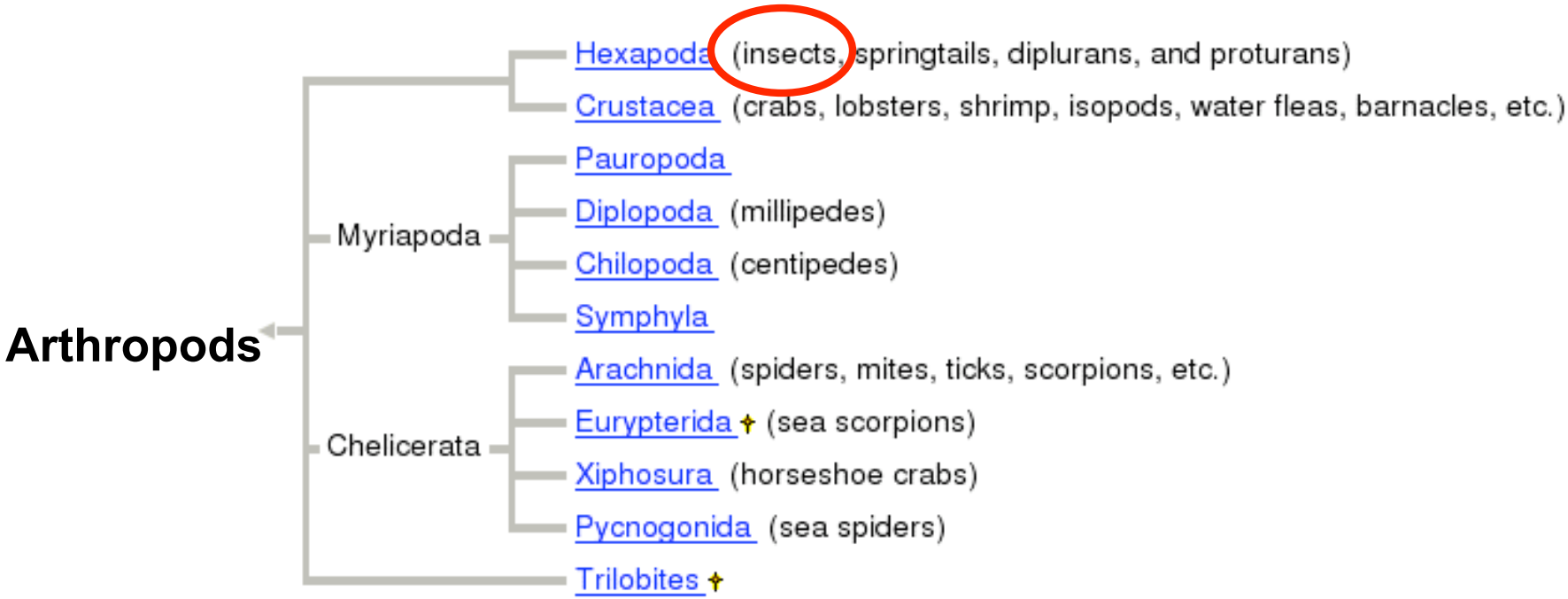
Taxonomy- process of describing, documenting, and classifying groups of organisms to facilitate further study.

Systematics- a study of biodiversity; finding uniting ties within groups of organisms and subsequently determining among group relationships and their evolutionary history.



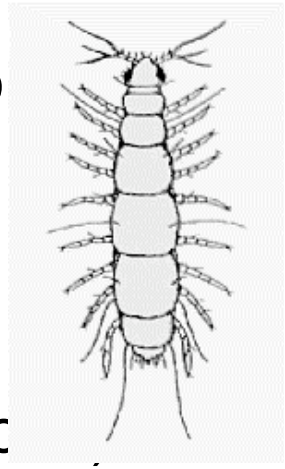
We can use systematics to find out how insects are related to the rest of the invertebrates….

1) Organization of the **phylum Arthropoda** according the tree of life website (http://tolweb.org/tree/phylogeny.html): shows crustaceans as closest living relative to insects



Although, as you will notice, the details have not yet been agreed upon……

2) Organization of the phylum Arthropoda according to your text book Triplehorn & Johnson (2005): insects mo closely related to centipedes and millipedes



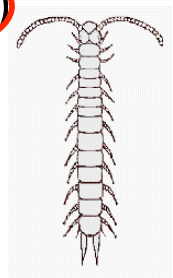
Trilobita (extinct)

Chelicerata (spiders, sea spiders, scorpic

Crustacea

Atelocerata

Diplopoda (millipedes)
Chilopoda (centipedes)
Pauropods (pauropods)
Symphylans (symphylans)
Hexapoda (Insecta)



Phylum **Subphylum** **Class**

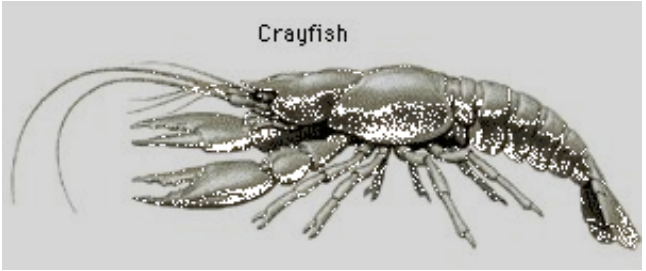
Main morphological characters used to separate arthropods from other invertebrates such as earthworms and nematodes:

1) Articulated Limbs: paired limbs which are jointed or segmented (*arthro*, joint/segment and *poda*, foot/appendage)

2) Hard (chitinous) exoskeleton which is secreted evenly over entire body surface

3) Body segmented into 2-3 distinct regions

4) Each body segment equipped with a pair of appendages**



Homology vs. Analogy

- Homology: character present in two or more taxa can be traced back to a common ancestor
  - Example 1

- Analogy: character present in two or more taxa CANNOT be traced back to a common ancestor
  - Example 2

It is hypothesized that these defining characters have lead to the incredible extant arthropod diversity

- Most species estimates range from 3-5 million, with the highest peaking around 10 million
- 80% of all animals are arthropods
- 3/5 of all arthropods are insects
- Amazing morphological diversity

It is this high morphological diversity which has been evolving for approximately 550 million (since the Cambrian explosion), that causes problems when researchers attempt to define relationships among and within these groups.

At first glance, the diverse morphologies of all of these insects appear to have little in common. But if we look closer we will notice….

- They all have six legs
- The external mouthparts are broken up into three domains
- Specific type of tagmosis (functional groupings of body segments, i.e. head, thorax)
- Compound and simple eyes
- Malpighian tubules (internal structures between the midgut and hindgut which facilitate excretory processes)
- Tracheal system with a particular spiracle arrangement
- Use of an “amniotic” egg to protect embryo and prevent drying

We also have discrepancies when looking at the relationships of groups within the class Insecta

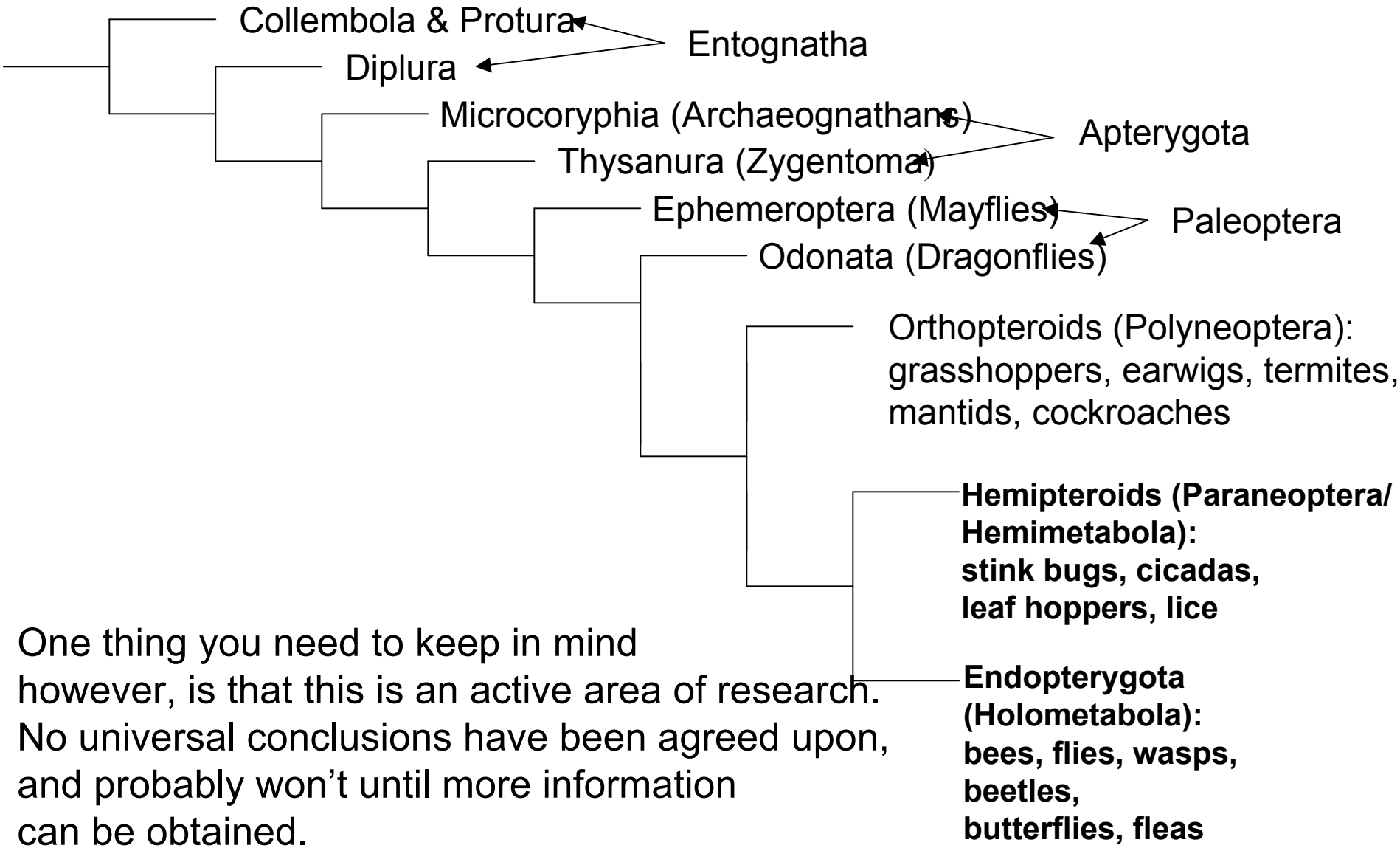
Again, we can use systematics to help us understand how the different orders within the class Insecta are organized

First, let's discuss what all of these terms mean

Class Insecta
Order Lepidoptera (butterflies and moths)
Family Nymphalidae
Subfamily Danainae
Genus *Danaus*
Species *plexippus*

This is how we *classify* the monarch butterfly.

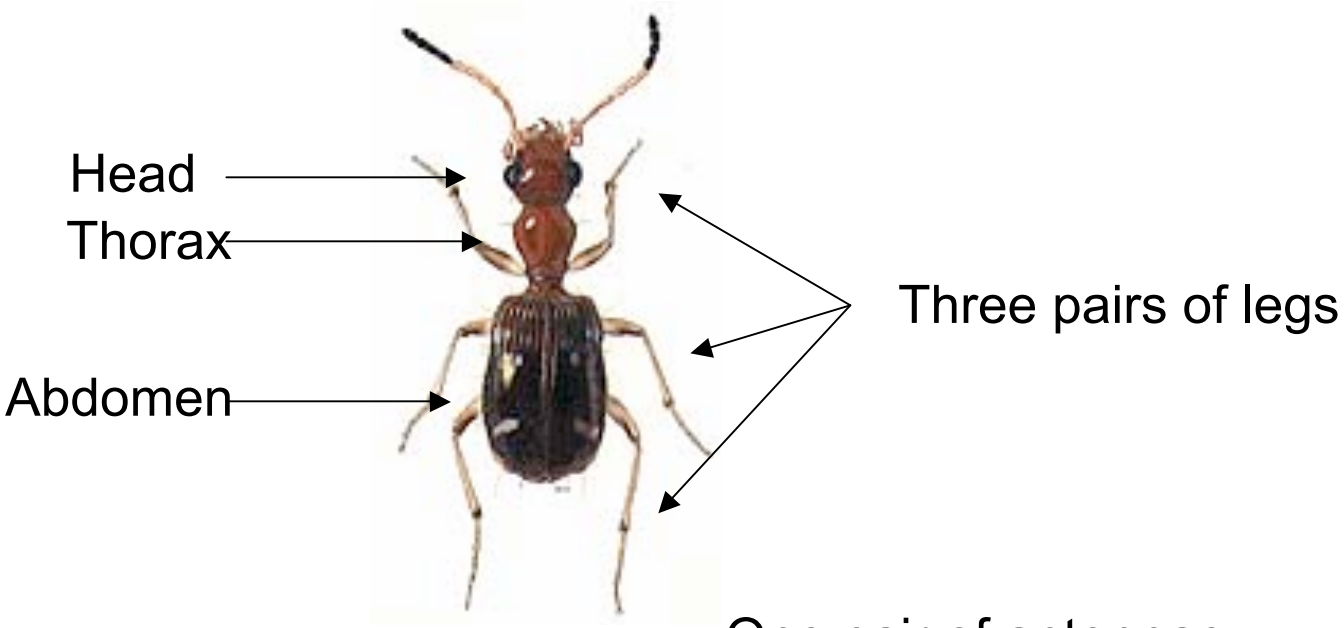
I am going to spare you the details of the argument and use the organization provided in the text book

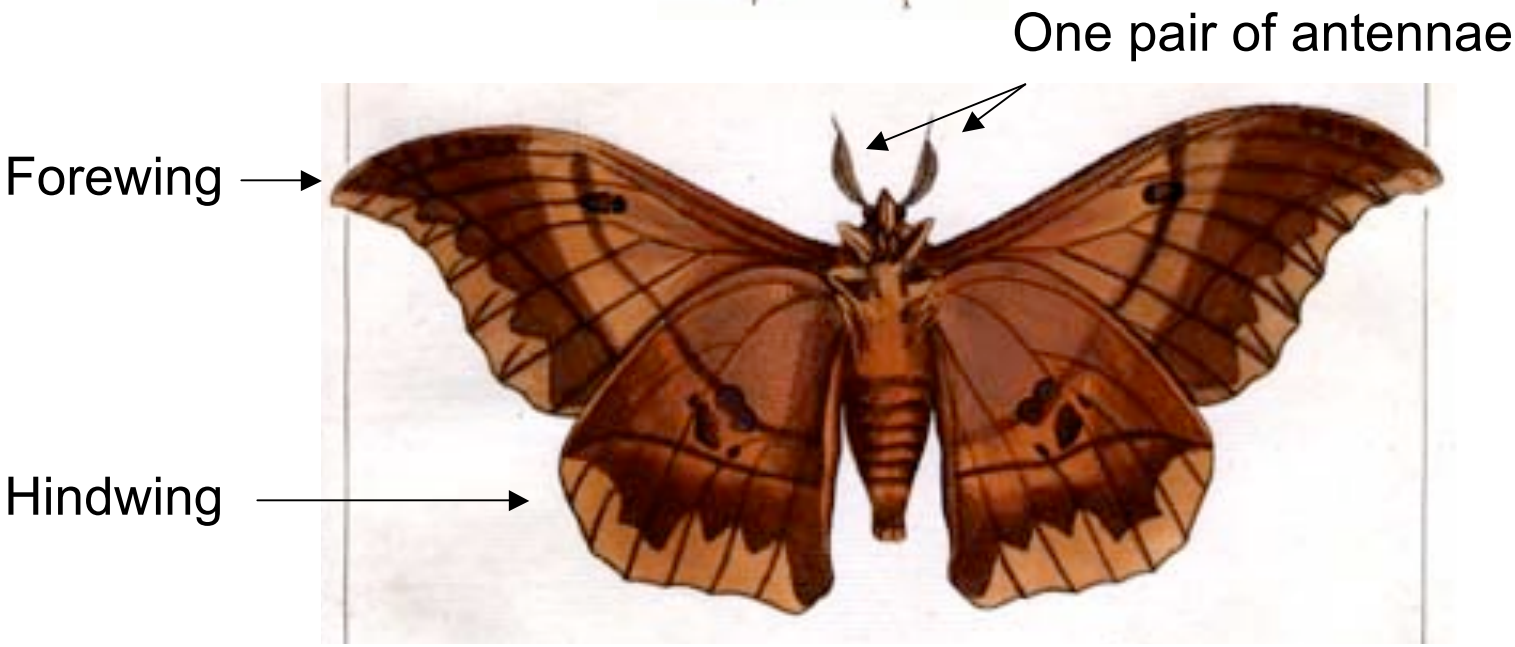


From Wheeler et al. 2001

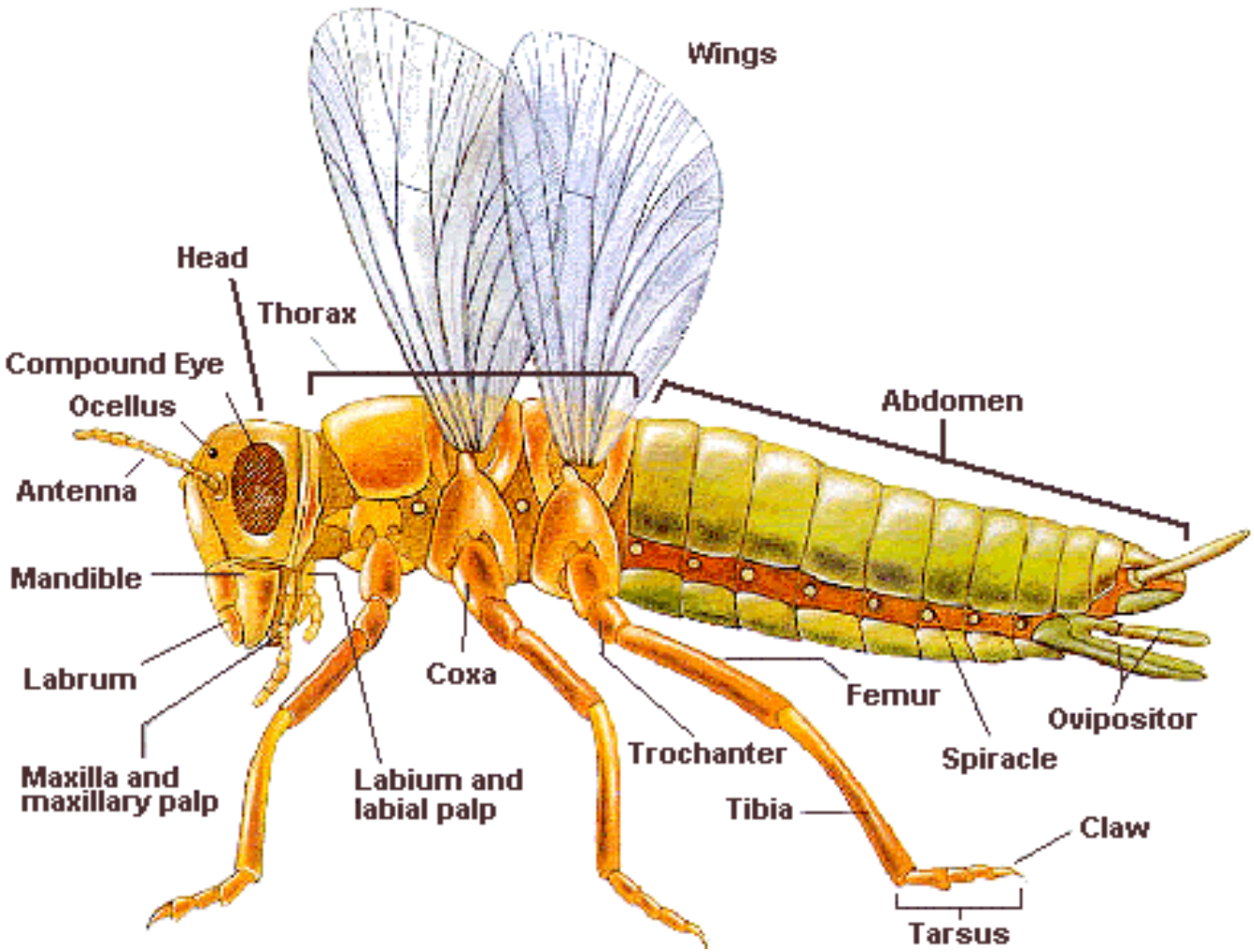
One thing you need to keep in mind however, is that this is an active area of research. No universal conclusions have been agreed upon, and probably won't until more information can be obtained.

General Insect Anatomy





General Insect Anatomy 2



The Integument

- Largest organ system
- Chitin and proteins
- Sclerotization: process of protein linkage
- Support and internal surfaces for muscular attachment
- Keep water in/out
- Feeding (mouthparts), Locomotion (wings and legs), Reproduction (genitalia)
- Diverse: provides most characters for insect identification

Interesting Cuticular Fact

- Sclerotization reduction in *Rhodnius prolixus* after a blood meal.
- Release of “plasticizing factor” that changes the pH of the cuticle and alters bonds between proteins allowing the abdomen to stretch.

By now, you have probably seen so many terms you may feel slightly overwhelmed. That's OK, let's go over some of them.

Entognatha- having internal mouthparts
Ectognatha- having exposed mouthparts
Apterygota- insects without wings
Pterygota- insects with wings
Endopterygota- wings develop within exoskeleton in the pupal stage
Exopterygota- wings develop on outside of body during nymphal stages
Hemimetabola- refers to a pattern of development. Immatures referred to as nymphs, gradually molt into adult form
Holometabola- immatures referred to as larvae (or caterpillars for butterflies and moths), and go through pupal stage before adult form is reached. Immature and mature form very different in appearance
Paleoptera- "old" wing, insects that have wings which cannot be folded over their back
Neoptera- "new" wing, insects that can fold their wings over their back

There is also a glossary at the back of your book and many online (although you may want to be careful of some of these). This one has been helpful to me: http://www.earthlife.net/insects/glossary.html

Knowing these characters is essential- please familiarize yourself with these using the dissecting scopes and grasshoppers provided

Head
Thorax
Abdomen
Exoskeleton
Abdominal sternites
Pro-, meso-, metathorax
Leg parts: coxa, trochanter, femur, tibia, tarsus
Antennae
Eyes
Clypeus
Labrum
Mandibles
Labial and maxillary palps

Familiarize yourself with the other Arthropod subphyla:

- Trilobitomorpha (trilobites)†
- Crustacea
- Chelicerata
- Myriapoda
- And, of course, Hexapoda