Insects and People -- Entomology 101
Green Blood and Guts - Internal Morphology

Internally, insects are every bit as complex as "higher" animals. As in all living creatures, the internal systems allow for growth, survival, and reproduction.

Internal Systems

1. Digestive: obtain and assimilate food, remove waste
2. Excretory: remove waste, salt and water balance
3. Respiratory: oxygen in, carbon dioxide out
4. Muscular: Movement
5. Circulatory: transport
6. Nervous: "Communication"
7. Reproductive: progeny
8. Endocrine: growth, reproduction, "change"

Digestive system

1. ingestion
2. digestion
3. absorption
4. egestion

Foregut: lined with cuticle; ingestion; predigestion; processing; storage

Midgut: not lined with cuticle; breakdown food particles (digestion); nutrients absorbed (assimilation); often modified to fit a food source

Hindgut: lined with cuticle; postdigestive processing; excretion and waste elimination

Excretory System

elimination of nitrogenous waste products and ionic balance in the body

1. Three primary types of nitrogenous waste product [N waste from protein (amino acid) breakdown].
    a. ammonia (aquatic insects; water in excess) H:N = 3:1
    b. urea (humans; water not at a premium) H:N = 2:1
    c. uric acid (most terrestrial insects; water conservation vital) H:N 1:1
2. Malpighian Tubules

Respiratory System

1. Cuticular diffusion (moist environment; modest oxygen demands)
2. Tracheal system (majority of insects)
   spiracle → tracheal tubes → tracheoles → oxygen to cell
3. Modifications
    a. tracheal gills (aquatic insects)
    b. breathing tubes (posterior spiracles - mosquito larvae)
    c. plastron (aquatic insects - "air bubble")
4. Carbon dioxide dissolves from cells into hemolymph and eventually leaves the body through the spiracular openings.

Circulatory System

1. Open circulatory system
2. A dorsal vessel: "heart" and aorta
3. Hemolymph ("blood")
    a. transport nutrients, hormones, waste
    b. store water and various ions
    c. provides pressure (hydrostatic support)
    d. no hemoglobin - rarely used to transport oxygen
    e. hemocytes - wound healing, coagulation, protection against infection

Nervous System

receives stimuli from environment, transmit nerve impulses, coordinates information into behavioral modifications

1. CNS: "brain" and ventral nerve cord w/associated ganglia (mass of neurons)
2. Three types of neurons
    a. sensory - receive input from environment - visual, auditory, taste, etc.
    b. motor - receive input from CNS - behavioral change
        "Run faster, human foot about to fall"
        "That looks like a nice meal"
        "She's cute"
    c. Association - communication between sensory and motor neurons