Practice questions

Phylogenetics
- What are three evolutionary lineages within Superclass Hexapoda, and what are distinguishing characteristics of each?
- What are three synapomorphies of Class Insecta?
- Recent evidence suggests what evolutionary origin of hexapods?

Morphology
- Describe the basic structure of the meso- or metathoracic segment of a neopteron.
- Describe the leg adaptations and habits of three insect families or orders that have different types of legs.
- Compare wing articulation in paleopterans and neopterans.

Evolution
- What are the evolutionary advantages that neopterans had over "paleopterans"?
- Discuss one hypothesis of how insect wings evolved
- Discuss one functional hypothesis of evolution of flight.

Respiration, Digestion and Excretion of Insects

- Systems approach
- Maintenance of homeostasis
  - Gas exchange
  - Nutrition
  - Water and salt balance
- Control and regulation of most inputs and outputs

internal anatomy in cross-section

tracheal system keeps gases in air

Fig. 3.10
Schematic of tracheal system
(a) an atriate spiracle with closing valve at inner end of atrium
(b) tracheoles running to a muscle fiber

Fig. 3.11: variation in tracheal systems
(a) Simple with valved spiracles (cockroach)
(b) Mechanically ventilated air sacs (honey bee)
(c) Metapneustic system with terminal spiracles (mosquito larva)
(d) Closed system with cutaneous gas exchange (endoparasitic larva)
(e) Closed system with abdominal tracheal gills (mayfly nymph)
(f) Closed system with rectal tracheal gills (dragonfly nymph)
Aquatic insects often have external gills and closed air-filled tracheal systems.

The insect as an integrated system

Don’t think of any organ system in isolation – all systems function in interdependent fashion within a larger system – the insect itself.

Generalized alimentary canal

Feeding specialization related to gut and mouthpart morphology

Preoral and anterior foregut morphology in (a) an orthopteroid insect and (b) a xylem-feeding cicada.

- Variation depends on diet
- May change during metamorphosis
Figure 3.15
Longitudinal section through the anterior body of a caterpillar of *Pieris rapae* (Lepidoptera: Pieridae)

Figure 3.16
Generalized scheme of the endo-ectoperitrophic circulation of digestive enzymes in midgut

Honeybee internal morphology; note the large flight muscles

Mosquitoes: larval and adult food acquisition

- Larvae: detritivorous filter feeders
- Adult females: ectoparasitic fluid feeders & nectar feeders
- Adult males: nectar feeders
- Major anatomical and physiological changes during metamorphosis

Proboscis of mosquito
- Sheath (labium) bends
- Stylets come out of grooves
- Finely toothed maxillae saws
- Fascicle guided into skin between labella

Proboscis cross-section
- 6 shafts w/in labial groove
  - 4 cut and pierce
  - 1 transports blood
  - 1 transports anticoagulant saliva
- Saliva also transmits disease
- Swelling & itch caused by allergic reaction
Hairy labella touches skin and maxillary paips raise. Labella spreads, maxillae saw into skin. Labium folds back, skin is punctured. Fascicle withdraws & springs upward and forward and returns to labial groove.

Adult female mosquito digestive system

http://www.scielo.br/img/revistas/mioc/v102n8/5889fig1a.gif

Malpighian tubules
- Number of tubules ranges from 0 (Collembola) to...
- 100s: Odonata, Hymenoptera, Orthoptera
- Most have <20

Insect, spider, & scorpion excretion

Fig. 3.18. Schematic of excretory system of desert locust (Orthoptera: Acrididae).

Only a few of the >100 Malpighian tubules shown. (a) Cross section of Malpighian tubule; solid arrows = active and dashed = passive processes (b) Movements in rectal pad cells during fluid resorption. Open arrows = water; black arrows = solutes.