Lecture outline -- Insect defense mechanisms

Insects live in a dangerous world! This lecture will introduce you to some of the bizarre ways that insects have evolved to protect themselves.

I. Non-chemical defenses:

(a) crypsis – hiding
(b) masquerade – looking like something you are not (backpack bugs)
(c) startle response – scaring the predator (hawkmoths, etc.)
(d) autotomy – losing legs and body parts can be adaptive! (walking sticks)

II. Chemical defenses

Insects often feed on highly toxic host plants. There are various things an insect might do with these toxic compounds:

1. elimination -- some insects can eliminate the toxic chemicals without ever absorbing them through the gut wall. *Eloria* (Lymantriidae) and *Erythroxylum coca* (cocaine)

2. metabolic detoxification -- insects can detoxify allelochemicals using mixed function oxidases (MFOs). Involves converting non-polar, lipid-soluble compounds to polar, water soluble compounds.

3. utilization of chemicals obtained from host plants or from *de novo* synthesis. Chemical defenses in insects are incredibly varied

(a) enteric discharge -- many arthropods regurgitate or defecate in response to attack.
(b) internal toxins -- steroids, alkaloids, cantharidin (*Lytta vesicatoria* [Meloidae]), hydrogen cyanide, histamine, acetylcholine.
(c) autohemorrhaging -- reflex bleeding.
(d) glands -- specialised glands for producing toxic compounds.
(e) spines, stinging hairs -- many Lepidoptera have spines and urticating hairs that irritate enemies.
(f) eversible sacs -- Lepidoptera
(g) salivary and mandibular glands
(h) tracheal glands -- *Romalea* and some cockroaches.
(i) chemical defense of eggs
(j) Bombardier beetles
(k) venoms -- Hymenoptera
(l) when defensive chemicals become pheromones – *Utetheisa ornatrix* (Lepidoptera) and *Neopyrochroa flabellata* (Coleoptera)

Role of predator learning: for many of these defensive mechanisms to work effectively against predators, predators must learn to associate the defensive behavior with the bug in the future. Many chemically protected insects are **aposematic** to reinforce predator learning.