THE INSECT WORLD: HIDDEN LIVES IN CENTRAL ILLINOIS

FACILITATOR

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Session 3 Questions – if you don't have the book, there is a WWW

Chapter 5: Feeding and Digestion

Gut architecture: The insect gut is divided into three distinct zones: the ectodermal foregut, the endodermal midgut, and the ectodermal hindgut. Why is it an evolutionary advantage for the foregut and hindgut to be lined with cuticle (and shed during molting), while the midgut is left unlined? What does this tell us about where the heaviest chemical processing occurs?

Peritrophic matrix: The midgut often secretes a delicate, sleeve-like membrane called the peritrophic matrix to enclose food. If this barrier protects the delicate midgut cells from sharp food particles and pathogens, how do parasites like Bt bacteria or specific viruses manage to breach it?

Surviving a toxic buffet: Many phytophagous (plant-eating) insects specialize in eating plants packed with deadly toxins (e.g., milkweed, tobacco, or nightshade). How do the digestive enzymes in an insect's midgut neutralize these chemical defenses, and what is the energetic trade-off of being a dietary specialist versus a generalist?

Nutrition extraction: Fluid-feeders like true bugs (Hemiptera) bypass the need for heavy grinding but face a different crisis: their food is mostly water and sugar, with very few amino acids. How does the "filter chamber" in their digestive tract allow them to concentrate nutrients while rapidly excreting massive amounts of watery waste (honeydew)?

Chapter 6: Respiration and Circulation

The slinky: The tracheal tubes of insects are lined with spiral ridges of cuticle called taenidia, which keep the airways from collapsing. Given that these tubes are made of cuticle, what happens to an insect's respiratory system when it molts? How does a large caterpillar or beetle larva manage to shed its old breathing tubes without suffocating in the process?

Abdominal pump: While small insects rely on passive diffusion, large or highly active insects (like bumblebees and grasshoppers) use active abdominal pumping. How can a naturalist observe this behavior in the field, and how does it change based on environmental temperature or the insect's immediate behavioral demands?

The dual systems: In vertebrates, the circulatory and respiratory systems are deeply intertwined via hemoglobin. In insects, they are almost completely independent. What are the evolutionary advantages of separating nutrient transport (hemolymph) from gas exchange (tracheae)? How does this separation allow an insect to survive severe crushing injuries that would cause a mammal to bleed out or suffocate?

Hydraulic skeleton: Beyond moving nutrients and immune cells, hemolymph serves a powerful mechanical function as a hydraulic fluid. How do insects utilize hemolymph pressure to emerge from a pupal case, expand their crumpled wings after eclosion, or even extend their legs (which often lack extensor muscles)?

If we have time…

Insect flight: Insect flight requires a massive, instantaneous surge in both oxygen delivery and nutrient circulation. How do the tracheal system and hemolymph work in synchronization to power a dragonfly or sphinx moth during high-speed flight?