Arthropod Materials

- Strategic goal: Understanding materials organization in arthropods from the nanoscale to the organismal scale and the relation of materials structure & property to the organism functionality

Current focus on
- Characterization of physical and chemical properties of arthropod exoskeleton
- Establishment of composition–microstructure–property relations
- Study on materials self organization at different scales
- Applications: Development of multifunctional materials that interweave nano and micro scales to make the materials functional, reconfigurable, and reactive to the environment.

Diversity of arthropod feeding habits: sponging, sucking and chewing mouthparts. Exoskeleton materials represent a wide variety of different combinations of six key properties: hardness, stiffness, strength, fracture toughness, density, and wettability. Our goal is to correlate these properties with underlying structures and compositions.

Materials multifunctionality: flexibility, maneuverability, sensibility, wettability... 

Butterfly proboscis is a remarkable example of multifunctional self-organizing material. When a butterfly emerges from a pupa, the galeas of the proboscis are separated. After the proboscis is “zipped” the cuticle hardens and galeas never come apart.

The proboscis features large (~1 μm) slits between dorsal plates of the linkage device. Also this region contains sensilla – “lab-on-chip” detecting and analyzing food.
Silk production and use in Arthropod world

- **Strategic goal:** This research aims to understand the physical principles used by arthropods for making fine and superstrong fibers with useful multifunctional properties.
- **Main challenge:** Silks are composed of proteins based on relatively simple amino acid repeats. The key missing information is the relationship between the protein sequence and the mechanical properties of the fibers.
- **Current focus on:**
  - Systematic study of the process of silk spinning
  - Systematic study of the mechanical and physicochemical properties of silks.
  - Analyses of water–silk interaction

Many arthropods including spiders, moths, and related groups, produce silk to assist in capturing prey and filter-feeding, as well as many associated processes. Spiders spin steel-strong fibers that are deployed as capture nets in a wide variety of structural and compositional forms and environments.