In every flying lineage, a part of the integument is modified to become part of the wing structure, and thereby takes on a novel function: interacting with the surrounding fluid to generate aerodynamic forces. The compliant skin of the wing distinguishes bats from all other flying animals, and contributes to bats’ remarkable, highly maneuverable flight performance and high energetic efficiency. Although recent research has begun to provide insight into the aerodynamic basis of flight in bats, the structural and functional complexity of the bat wing membrane is largely unstudied, remaining one of the least understood although important elements of the bat flight anatomy. In fact, how wing skin mechanics influences flight dynamics may be the most poorly understood aspect of bat flight. Here, we take a mechanistic approach to study skin material behavior. Recent advances in developing a combined theoretical and experimental framework to describe the morphology, structure, and mechanical behavior of thin elastomeric membranes are presented. Skin is a natural paradigm for thin multifunctional materials for a range of mechanical, biomedical, and aerospace applications. This presentation will focus on the mechanics of crosslinked elastomers - materials capable of large, reversible deformations. Their use and potential is widespread in current applications as well as new areas of research. For example, in electroactive polymers, stretchable thin organic solar cells, soft robotics, soft pressure sensors, which intend to mimic the tactile sensing properties of skin, and various components in the construction of soft electronics, like high-energy storage capacitors all rely on the remarkable large-stretch properties of elastomeric materials. Particularly of interest are flapping wing micro air vehicles that could offer the potential benefits of extreme maneuverability in limited airspace, including ingress and egress of buildings and areas not accessible to humans.