Biological materials are remarkable in their ability to respond to environmental stimuli, transitioning from fluid-like to solid-like behavior in response to different conditions. To better understand these biological systems, discrete lattice structures can be used to accurately represent the highly sensitive particle interaction and deduce microstructure evolution. In this work, we create a discrete 2D lattice model that can be extended to the continuum level using multi-scale modeling. While the lattice model is an effective method for studying microstructure evolution, designing a lattice structure for a specific requirement can be challenging due to the complex nonlinearity between lattice configuration and mechanical behavior. The goal of this study is to develop a lattice spring model that accurately represents the mechanical behavior of a microstructure. In addition to numerical calculations, we will be utilizing machine learning techniques to predict the mechanical response of our lattice model. Specifically, we will be employing a neural network to accurately predict the stress tensors that correspond to a given strain tensor for any lattice configuration. This approach allows us to overcome the limitations of traditional lattice design methods, which rely heavily on trial and error. By training our neural network on a large dataset of strain-stress pairs, we can learn the underlying patterns and relationships between lattice configurations and mechanical responses. This information can then be used to design new lattice structures that exhibit desired mechanical properties, such as high strength or flexibility. By combining numerical simulations and machine learning, we hope to gain a deeper understanding of the mechanical behavior of biological systems and pave the way for the design of more effective lattice structures for a wide range of applications.