This study examines the impact of electrode configuration on the neural activity of a cockroach leg. Using a straightforward electrophysiology setup, action potentials were recorded to investigate how electrode distance and size influence signal amplitude, frequency, and noise levels. Electrodes were tested at various locations along the tibia and femur, with a larger electrode serving as the control, while electrode size and distance were systematically varied. The results revealed that signal amplitude increased with electrode distance, likely due to changes in the number of neuron groups detected by the reference and recording electrodes. Additionally, within a controlled distance, signal amplitude was positively correlated with electrode size, while frequency showed an inverse relationship, suggesting that electrode size affects spatial resolution as well as impedence. This work highlights the significance of optimizing electrode placement and size in electrophysiological studies to enhance neural detection. These findings offer valuable insights for refining experimental designs in neural recording applications.