Bioluminescence, which is rare on land, is extremely common in the deep sea, being found in 80% of the animals living between 200 and 1000 m. These animals rely on bioluminescence for communication, feeding, and/or defense, so the generation and detection of light is essential to their survival. Our present knowledge of this phenomenon has been limited due to the difficulty in bringing up live deep-sea animals to the surface, and the lack of proper techniques needed to study this complex system. However, new genomic techniques are now available, and a team with extensive experience in deep-sea biology, vision, and genomics has been assembled to lead this project. This project is aimed to study three questions 1) What are the evolutionary patterns of different types of bioluminescence in deep-sea shrimp? 2) How are deep-sea organisms' eyes adapted to detect bioluminescence? 3) Can bioluminescent organs (called photophores) detect light in addition to emitting light? Findings from this study will provide valuable insight into a complex system vital to communication, defense, camouflage, and species recognition. This study will bring monumental contributions to the fields of deep sea and evolutionary biology, and immediately improve our understanding of bioluminescence and light detection in the marine environment. In addition to scientific advancement, this project will reach K-college aged students through the development and dissemination of educational tools, a series of molecular and organismal-based workshops, museum exhibits, public seminars, and biodiversity initiatives.