Title of Project: Molecular Characterization of Fish Swimbladder Development: Implications of the Origin and Evolution of Lung in Tetrapods

Name of Supervisor: Gong Zhiyuan and Vladimir Korzh

Contact Details: Gong: dbsgzy@nus.edu.sg; Korzh: vlad@imcb.a-star.edu.sg

Short Description
One of the most important evolutionary novelties in vertebrate evolution is the appearance of the lung as a respiratory organ. However, how the lung evolved remains a long-standing riddle in biology and life sciences. It is believed that the buoyancy organ in fish, the swimbladder is a homologue of the lung. And yet this viewpoint is rather controversial. While the lung is a highly branched organ, the swimbladder is not. We envision that molecular analyses of expression patterns of homologous genes expressed in the swimbladder and lungs and experimental manipulation of developmental mechanisms involved in formation of these organs should provide clues that would demonstrate whether the swimbladder and lungs have a common evolutionary origin or not. In the current proposal, we intend to employ both genomic and developmental approaches to compare the mouse lung and fish swimbladder. Since most of the information about lung gene expression and development in mice is available from public databases and literature, we will focus on two fish models, the zebrafish (Danio rerio) with a typical unbranched swimbladder and the lungfish (Protopterus annectens) that use the swimbladder for respiration. We will analyse both the transcriptomic and proteomic profiles for zebrafish and lungfish swimbladders in comparison with those of mouse lung. We will also investigate the molecular mechanisms of swimbladder development in the two fish species, with a particular focus on the set of genes that are involved in branch morphogenesis in lung development as they are likely behind the divergence of the two different organs. By these analyses, we hope to provide molecular and developmental evidence about the origin of lung in evolution.