Exploring Posterior Growth in D. rerio Using a Live Cell Cycle Biosensor

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Though cell cycle regulation plays a key role in numerous developmental processes, including morphogenesis and differentiation, the regulatory systems that control the cell cycle remain poorly understood. Surprisingly, past studies have shown a correlation between invasive behavior and G1 cell cycle arrest. To explore this relationship, a cell cycle state biosensor has been adapted for use in zebrafish. The sensor provides a visual readout of cell cycle state based on the localization of DNA Helicase B (DHB), which is determined by cyclin-dependent kinase 2 (CDK2) activity. The sensor was validated by comparing it with Fluorescence Ubiquitin Cell Cycle Indicator (Fucci) and characterized it by inducing G1/S phase cell cycle arrest through treatment with Palbociclib and hydroxyurea. The effects of cell cycle dysregulation on tailbud development were also explored. Overexpression of CDKN1A/p21, a cyclin- dependent kinase inhibitor, was found to induce G1 cell cycle arrest in tailbud cells and disrupt development by forcing additional cells to invade into the notochord. Our sensor provides new evidence for the hypothesis that G1 cell cycle arrest induces invasive behavior and lays the foundation for understanding the relationship between cell cycle regulation and invasion, a concept that is critical to our understanding of cancer metastasis.

Awards Won:
Intel ISEF Best of Category Award of $5,000
First Award of $5,000
American Committee for the Weizmann Institute of Science: All-expense paid four week trip and scholarship to the Bessie Lawrence International Summer Science Institute