

Targeted Project / AY 2023 -2024

Structure, dynamics and evolution of a gene network timing neural specification in vertebrate embryos

Supervisor: Dr Ben Steventon (bjs57@cam.ac.uk)

Department/Institute: Genetics

Co-supervisor: Dr Teresa Rayon (Babraham Institute)

Research area: Developmental biology

Project outline:

During vertebrate development, the specification and maturation of the spinal cord is coordinated with the progressive elongation of the posterior body. This process is spatiotemporally regulated by developmental transcription factors such as Cdx, SoxB and Zic paralogs, intercellular signalling pathways such as Wnt, and embryo morphogenesis. We plan to characterize the Wnt/Cdx/SoxB/Zic network in vertebrate embryos, which may be derived from an ancient anteroposterior patterning network conserved across bilaterian animals. We want to understand the structure and intrinsic dynamics of this network, its regulation by extrinsic signals, and how it varies across species with different development rates and modes of morphogenesis. The core of this PhD project will involve characterizing Cdx, SoxB and Zic expression in wild-type and mutant zebrafish embryos, using multiplexed HCR staining, confocal microscopy, and computational image analysis.

The student will also analyse single cell sequencing datasets to identify additional network components and assess whether developmental trajectories predicted from these datasets accurately reflect their observation in vivo. Later in the project, the student will have the opportunity to compare the dynamics of the network across the wide range of vertebrate models used in the Steventon and Rayon labs, including chick embryos, mice embryos, and human cell lines. They could also get involved in computational modelling and simulation of the network, to understand its spatiotemporal dynamics. This project will provide the student with well-rounded training in the concepts and techniques of modern developmental biology, as well as a stimulating and collaborative research environment.

BBSRC DTP main strategic theme: Understanding the rules of life

BBSRC DTP secondary strategic theme: Transformative technologies, Bioscience for an integrated understanding of health