Science and Technology Group
Annual Report FY2016

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1 Introduction

The past year has seen further progress in collaboration with the Luscombe unit in developing single-cell RNA-seq work in *Ciona* as well as experimental techniques in *Oikopleura dioca*.

2 Activities and Findings

1. Single-cell measurements in *Ciona*

It is important to have measurements of transcription factor levels and gene outputs at single-cell resolution. Spatially averaging transcription factor measurements obscures cellular state and hence limits the effectiveness of statistical studies of the regulatory inputs and outputs in the cell. Therefore, to understand gene regulation, it is crucial to develop approaches for measuring gene expression at the single-cell level.

Previously, we generated a complete dataset of single-cell expression data at the 16-cell embryo stage in *Ciona robusta*, a marine chordate. Following on from the successful analysis of these data, experimental and computational work began at other stages in *Ciona*. In addition to supporting this work, I developed and tested my computational approach for finding single-cell patterns in Ciona while experimental validation continued for the previous 16-cell embryo analysis.

2. Establishment of *Oikopleura dioica* experimental techniques

Over the past few years, the Luscombe Unit has developed expertise and knowledge working with *Ciona*, an invertebrate marine chordate. Future experimental work will benefit from having an organism similar to *Ciona*, but with a shorter lifecycle. *Oikopleura dioica* is such an animal. In the previous year, we established a reliable culture of *Oikopleura dioca* at OIST using animals kindly supplied by the lab of Hiroki Nishida at Osaka University.

During FY2016, we further developed our culturing of *Oikopleura dioca* to improve longer-term (> 26 weeks) stability. We also began to improve our culture of local *Oikopleura dioca*, including measuring local sea conditions and seasonal variability of *Oikopleura* at the shore near OIST. The local organism has proved harder to culture, so we will need to continue looking for ways to optimise and improve this.

One of the major goals of using *Oikopleura* in this collaboration is transgenic work. With the help of the Sars International Centre for Marine Molecular Biology in Bergen, Norway, we introduced *Oikopleura* microinjection techniques. We also designed and initiated a pilot study using CRISPR in *Oikopleura.*

3 Collaborations

Theme: Measuring gene expression with single-cell RNA-seq
Type of collaboration: Joint Research
Researchers: Luscombe Unit (OIST)

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4 Publications and other output

Oral Presentation at *58th Annual Drosophila Research Conference*. Quantitative and predictive models of even skipped and rhomboid enhancers targeted by engineered transcription factors in the early Drosophila embryo. March 2017

Seminar in the Department of Genetics, University of Barcelona. In vivo control of gene expression. September 2016

Oral Presentation at the *International Conference on Systems Biology*, Barcelona. Models of enhancer regulatory function can predict perturbations accurately after training on single-cell expression data. September 2016