Fate choice and cell size sensing in centric diatoms
FATE

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Abstract

How does a single cell choose what to become and how does it know how big it is? This project aims to study two basic problems in cell biology looking at the unique transitions of diatom life cycles, clarifying the genetic networks that control these transitions. Diatoms are photosynthetic unicellular eukaryotes ubiquitous in aquatic habitats. Sexual reproduction in diatoms introduces genetic diversity and counteracts a progressive cell miniaturization happening during mitosis because of the asymmetric rigid cell wall. Centric diatoms are homothallic, the same strain can produce both sperms and eggs, however this happens only when cells are below a specific size. A unique feature of the diatom life cycle is indeed the difference between larger cells, that are not competent for sex, and smaller ones, competent for sex. This project will address three pending questions in diatom reproductive biology: I) What is the genetic program underlying the cell choice of developing into either sperms or eggs? II) How do environmental triggers hinge on this program? III) How do cells tell their size and what triggers competence for sex after a given size threshold is reached?
The candidate is expected to select and isolate suitable species, define the environmental triggers and timing of the appearance of sperms and eggs, apply single-cell transcriptomics to dynamically identify the transcriptomic profile of cells while they perceive the trigger and choose whether and which gamete to produce. He/she will also apply confocal and expansion microscopy to image cytoskeleton and organelles during transitions, especially for the size threshold switch. Finally, *in situ* meta-omics data from long-term observatories and oceanic and coastal expeditions will be analyzed to estimate sex events at sea and correlation with environmental parameters.
The mechanisms and endogenous controls that regulate diatom sex in nature are unknown. Eventually, gene networks involved in fate choice and cell size perception and control will be defined and these signals will be followed in the natural environment. This will contribute to place single organisms' information in the context of ecosystems, allowing to generalize concepts on cell function and integrate them with mechanisms at sea.