The Chordate phylum groups vertebrates, tunicates (including ascidians) and cephalochordates (amphioxus). These animals share a typical body plan characterized by the presence during embryonic life of a notochord and a dorsal neural tube. Ascidians, however, took a significantly different evolutionary path from other chordates resulting in divergent morphological, embryological and genomic features. Their development is fast and stereotyped with very few cells and ascidian genomes have undergone compaction and extensive rearrangements when compared to vertebrates. This raises the question of whether developmental mechanisms controlling typical chordate structure formation are conserved between ascidians and vertebrates.

In addition, ascidians have extensively diversified (around 3000 species) and their genomes have been reshuffled to the point that there is very little DNA conservation outside of the coding parts of the genome. Yet, their embryos are virtually identical. Since ascidians are excellent models for functional genomics, in particular with plasmid DNA electroporation that allows the easy generation of thousands of transient transgenic embryos, they offer an excellent opportunity to probe the diversification of the developmental mechanisms and the evolution of cis-regulatory non-coding DNA (enhancers).

We and others have studied the cellular and molecular specification of the caudal peripheral nervous system in the ascidian Ciona intestinalis. Signals of the Bmp, Fgf, Nodal and Wnt pathways specify neurogenic territories and launch a regulatory network of transcription factors controlling neuron specification and differentiation. We have uncovered original usages of the signaling molecule Nodal and the transcription factor Otx. For example, Otx which is a specific determinant of anterior identity in most metazoans has been co-opted for the formation of the ascidian posterior nervous system. These two factors define a regulatory signature found in enhancers of posterior neural genes in two genomically divergent ascidian species.

The PhD project aims at using the above gene regulatory network (GRN) to probe the modifications that may have occurred during ascidian diversification and evolution. Our group, being located at the marine station of Banyuls-sur-mer, benefits from the access to a variety of ascidian species. We have developed the embryological methods and transcriptomic resources for several species that cover the different ascidian families. By using a variety of experimental approaches, the PhD student will probe GRN evolution at different levels:

- gene expression profiles (in situ hybridization)
- GRN architecture and gene function (electroporation mediated gain- and loss-of-function)
- enhancer activity (cross-species in vivo assays and CRISPR/Cas9 mediated genome editing)


### Thèses actuellement en cours dans l’équipe

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### Trois publications récentes du directeur de thèse


### Docteurs encadrés par le directeur de thèse
