

# Signalling in morphogenesis

**Principal Investigator**  
Jordi Casanova (CSIC)

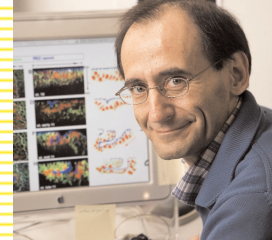
**Research Associates**  
Andreu Casali  
Marc Furriols

**Postdoctoral Fellows**  
Sofia Araujo  
Veronique Brodu  
Daniel Shaye

**PhD Students**  
José de las Heras  
Gemma Ventura

**Research Assistants**  
Nicolás Martín

**Lab Technicians**  
Carlota Costa  
Raquel Méndez



Jordi Casanova

The development of multicellular organisms requires changes in cell populations in terms of their proliferation, differentiation, morphology and migration. These synchronised changes are controlled by the genes that specify cell fate and by the capacity of cells to respond to extracellular cues. This is achieved by means of signalling mechanisms that elicit cellular responses that ultimately are responsible for the morphogenetic events that occur during development. Two key steps in these events are the mechanisms that regulate the appropriate spatial and temporal activation of the signalling pathways and the mechanisms that link these pathways with the cell effectors in order to elicit cell responses in terms of gene activity or cell morphology. Our research efforts focus on the study of these phenomena in the context of the whole organism. The basic similarity between developmental processes in different species justifies the choice of an organism as a model system, in our case *Drosophila melanogaster*. In particular, we analyse the above mechanisms in two model systems in this fly, the Torso receptor signalling pathway and the tracheal system morphogenesis.

## The *torso-like* gene as a transducer of ovarian positional information for the activation of the Torso receptor in the embryo

To address the control of activation of signalling pathway activation, we analyse how the positional information from one tissue can be used to differentially activate a signalling pathway in another group of cells. In particular, we study the role of the gene *torso-like* (*tsl*) as a transducer of the positional information from the ovary to the embryo. As a consequence of *tsl* activity, the Torso RTK receptor is activated only in embryonic regions that correspond to the areas of the oocyte that had previously been in apposition to the follicle cells expressing the *tsl* gene. (See Figure 1).

We have functionally dissected the *tsl* promoter by means of the analysis of fusions of various fragments of the promoter with the lacZ gene in transgenic flies. We have identified distinct enhancers responsible for the expression of the gene in several populations of follicle cells in the ovary. We are currently using these constructions and their regulation in a number of mutant backgrounds to identify the putative elements that regulate their expression. We have also taken advantage of these enhancers to generate GAL4 lines to examine the functional significance of *tsl* expression in groups of cells, either by crossing them with a UAS-*tsl* line and checking whether they can rescue *tsl* mutants or by crossing them with a UAS-*tsl*RNAi line to verify whether they generate *tsl* phenotypes.

## Analysis of Capicua as a regulator of gene transcription by the Torso RTK pathway

Regarding signalling effectors, we study the regulation of the activity of the transcriptional repressor Capicua by the Torso pathway as a link between signalling and gene activity. Specification of the terminal regions of the *Drosophila* embryo depends on the Torso RTK pathway, which triggers expression of the zygotic genes *tailless* (*tll*) and *huckebein* (*hkb*) at the embryonic poles. However, it has been shown that the Torso signalling pathway does not directly activate expression of these zygotic genes; rather, it induces their expression by inactivating, at the embryonic poles, a uniformly distributed repressor activity that involves the Groucho (Gro) co-repressor.

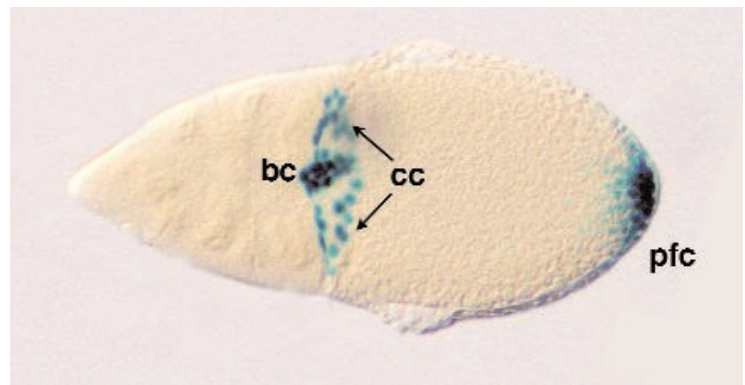


Figure 1. *tsl* expression in the eggchamber as visualized by a *tsl-lacZ* construct. Expression can be detected in the border cells (bc), the posterior follicle cells (pfc) and in the centripetal cells (cc).