

# Examples of Gene Expression During Ontogenesis

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Differentiated cells adopt very different forms and perform different functions although all cells of an organism contain the same genetic information. They all arise from a single fertilized egg. During embryonic and later ontogenetic development the permanent cross-talk between proteins and genes leads to differential gene activity which directs the cells along different developmental pathways.

Fertilization completes the diploid chromosomal number and initiates the astonishing process of development of a new living being. The proteins and mRNAs deposited into the egg cell by the mother are necessary for the first developmental events, whereas the genes in the nucleus carry the information for new proteins, which take over the developmental process. During the development the fertilized egg divides asymmetrically. The daughter cells inherit the same genetic material but different cytoplasmic instructions and therefore activate different genes. During numerous successive regulatory events in subsequent cell divisions the biochemical differences among cells increase. Additionally, cells respond to extracellular signals which also influence differential genetic expression and cell differentiation. More and more specific regulatory molecules limit the developmental potential of each cell until different differentiated cell types arise.

In the fruit fly, a complex spatial pattern of regulatory molecules arises before the first cell divisions. This pattern provides positional information for emerging cells and specifies their future competence. The germ bands endo-, meso- and ectoderm are specified. In the ectoderm proneural gene expression defines the regions of neuroectoderm which adopt the potential for the development in the nervous tissue. In the neuroectoderm, the intercellular communication singles out the real neuronal precursors. They undergo a series of stereotypic asymmetric cell divisions, which result in determined cell types. After the cell fate is determined, the cells undergo differentiation which appears to be an interactive process as well. The signals from the environment acting through the specific receptors in the cell membrane influence the gene expression in the cell and thus regulate its metabolism and form.