10 Development and evolution

> The turn of the century saw the emergence of genetics, embryology, and evolutionary biology as three separate fields. Before that time, they were approached as a single discipline, and the term *development* applied to them all. By 1926, however, the three sciences had their own journals, their own textbooks, and their own jargon. Moreover, each discipline had largely ceased referencing papers in the other two fields. The geneticists studied the transmission of inherited traits, the embryologists studied the expression of these traits, and the evolutionary biologists studied the changes, selection, and propagation of these traits over many generations. – Gilbert (1988, p. 631)

Genetics and development

Embryological development has long been considered key to understanding major features of evolution. Following von Baer (1828), Darwin emphasized the similarity of early developmental stages as evidence of the interrelationships of the major groups of vertebrates, and many other scientists have argued that the progressive changes that are seen in embryogenesis reflect the changes that occurred during evolution (e.g., Haeckel 1866; Gould 1977; Thomson 1988; Hall 1992). Despite the obvious role that changes in developmental patterns and processes must have played throughout the history of life, developmental biology did not contribute significantly to the formulation of the evolutionary synthesis (Mayr and Provine 1980; Gilbert et al. 1996). The major new support for the validity of Darwinian selection theory came not from embryology but from an understanding of the nature of inheritance, knowledge of the quantitative importance of mutation and selection, and appreciation of the significance of speciation.

Since modifications in developmental patterns and processes presumably reflect changes in genes comparable to those that have long been studied by geneticists and population biologists, it seems ironic that genetics has long overshadowed developmental biology in studies of the mechanics of evolutionary change. In fact, there are significant differences between the nature of the majority of genetic differences studied by evolutionary biologists and of those that contribute to understanding the embryological patterns and processes of interest to developmental biologists.

Developmental biology is the study of the factors that control the differentiation of individual cells and their organization into the many different tissues, organs, and organ systems of multicellular organisms. Development in vertebrates begins with a single fertilized egg, bearing the combined genetic components of the two