UNIT

Growth and Development

Web Chapter

14 Gene Expression and Signal Transduction

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Each living cell contains a set of instructions for building the entire organism, consisting of genes linearly arranged in the form of chromosomes. This fundamental concept in biology began with Mendel's genetic studies with garden peas in 1865, and culminated with Watson and Crick's discovery of the structure of DNA in 1953. But the story did not end there. A new field of molecular biology arose focused on the structure, replication, and expression of genes. Genes encode proteins, and elucidation of the elaborate machinery involved in transcription and translation was one of the early triumphs of the new field of molecular biology. More recently, molecular biologists have sought to understand how gene expression is regulated, for it turns out that the genetic "instructions" found on the chromosomes are incomplete without a full complement of regulatory proteins from the cytoplasm to direct their activity. In this chapter we will review basic concepts in gene expression in prokaryotes and eukaryotes.

While molecular biologists were studying cell function from the gene outward, developmental biologists were tracking the signals that regulate development, both external and internal, from the "skin" inward. They discovered that developmental signals, such as light or hormones, involve specific receptors and typically require amplification in the form of "second messengers." Ultimately these second messengers regulate the activities of crucial processes, such as membrane transport or gene expression, which bring about the physiological or developmental response. Thus developmental and molecular biologists approach the same problem from opposite directions. The second part of this chapter provides an overview of various signaling mecha-

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nisms found in living cells. The models presented are derived mainly from animal and microbial systems, in which they were first discovered. Related mechanisms in plants will be discussed in the various chapters of the text devoted to development, light, and hormones.