



*Figure 10.1.* Diagrammatic representation of chordate development from fertilization to organogenesis. By the morula stage, the cells form a hollow sphere. During gastrulation, three types of embryonic tissues, termed the *germ layers*, develop. The external surface of the gastrula is made up of the *ectoderm*, which later forms the skin and much of the central nervous system. The gut develops by invagination at the blastopore; its lining is formed by the *endoderm*. A third tissue, the *mesoderm*, forms by outpocketing of the gut. It has two layers, separated by an open space, the *coelom*. The mesoderm forms the muscles, most of the bones, and other internal structures of the adult.

parents. Cell division that begins in the zygote eventually produces all the cells of the adult organism, all of which carry the same genetic information whether they are brain cells, muscle cells, or the cells that produce bone and cartilage. The key to cell differentiation is the activation and regulation of particular genes in the precursors of each different kind of cell. Cell fate is also influenced by where cells are located in the body, their relationship to other cell types and tissues, and the timing of their genetic activation.

Determination of the anterior–posterior and dorsal–ventral axes of the body is among the earliest developmental events, closely followed by the establishment of the body regions and germ layers (Fig. 10.1). This determines the framework or body plan within which organs and organ systems develop. From this pattern, structural features that distinguish each of the major vertebrate groups are rapidly elaborated. It is only late in development, when their anatomical patterns are nearly fully formed and the young are close to hatching or birth, that the traits commonly studied in classical genetics become evident. Many, such as the color of the flowers or the stature of the plant or animal, are manifest only when the organism reaches maturity.

In general, the earlier a gene is expressed, the greater influence it can have on subsequent events during development and the more likely that its disruption will result in malformation and death. According to studies reported by Gilbert (1988, p. 187), at least 50 percent of human conceptions abort spontaneously within the