A number of physiologic functions are altered in response to some of the pubertal changes. The size and strength of the heart, blood volume, and systolic blood pressure increase, whereas the heart rate decreases (see inside back cover). Blood volume, which has increased steadily during childhood, reaches a higher value in boys than in girls, a fact that may be related to the increased muscle mass in pubertal boys. Adult values are reached for all formed elements of the blood. The lungs increase in both diameter and length during puberty. Respiratory rate decreases steadily throughout childhood and reaches the adult rate in adolescence. Respiratory volume and vital capacity are increased and to a far greater extent in males than in females. The rate of steady decline in basal metabolic rate from birth to adulthood slows during puberty. During this period, physiologic responses to exercise change drastically: performance improves, especially in boys, and the body is able to make the physiologic adjustments needed for normal functioning after exercise is completed. These capabilities are a result of the increased size and strength of muscles and the increased level of cardiac, respiratory, and metabolic functioning.

Cognitive Development Emergence of Formal Operational Thought (Piaget)

Cognitive thinking culminates with the capacity for **abstract thinking**. This stage, the period of **formal operations**, is Piaget's fourth and last stage. Adolescents are no longer restricted to the real and actual, which was typical of the period of concrete thought; now they are also concerned with the possible. They think beyond the present. Without having to center attention on the immediate situation, they can imagine a sequence of future events that might occur, including college and occupational possibilities; how things might change in the future, such as relationships with parents; and the consequences of their actions, such as dropping out of school. At this time, their thoughts can be influenced by logical principles rather than just their own perceptions and experiences. They become increasingly capable of scientific reasoning and formal logic.

Adolescents are capable of mentally manipulating more than two categories of variables at the same time. For example, they can