

Control and Movement

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Summary of Terms

- **Acetylcholine** The neurotransmitter used by motor neurons to communicate with muscle cells at the synapses that connect the two.
- **Actin** Along with myosin, one of the two types of filaments in sarcomeres that work together to cause muscle contraction.
- **Amnion** A membrane that surrounds a developing embryo. It is filled with amniotic fluid, which cushions and protects the embryo.
- **Androgens** Sex hormones involved in sperm production as well as the development of some male secondary sexual characteristics.
- **Anterior pituitary** The “master gland,” many of whose hormones regulate the activity of other endocrine organs.
- **Antidiuretic hormone** A hormone made by the posterior pituitary that helps the body conserve water by producing a more concentrated urine.
- **Bone marrow** The jellylike substance at the center of bones that makes red and white blood cells (red bone marrow) or stores fat (yellow bone marrow).
- **Estrogens** Sex hormones that, together with progestins, regulate ovulation, the menstrual cycle, and pregnancy. Estrogens also promote certain female secondary sexual characteristics.
- **Gametes** Haploid sex cells, such as eggs and sperm.
- **Fertilization** The joining of an egg and a sperm to form a diploid cell that can develop into a new organism.
- **Growth hormone** A hormone made by the anterior pituitary that promotes growth.
- **Hormones** Molecules that give instructions to the body. They are produced in one place in the body, released into the bloodstream, and received by target cells elsewhere in the body.
- **Insulin** A hormone made by the pancreas that acts to decrease blood glucose levels.
- **Melatonin** A hormone produced by the pineal gland that regulates the body’s internal clock.



- **Myosin** Along with actin, one of the two types of filaments in sarcomeres that work together to cause muscle contraction.
- **Ovaries** The organs in females where eggs are produced.
- **Ovulation** The release of a mature egg cell that occurs once during each menstrual cycle.
- **Placenta** The organ that allows nutrients and wastes to be exchanged between a pregnant woman and a developing embryo.
- **Progestins** Sex hormones that, together with estrogens, regulate ovulation, the menstrual cycle, and pregnancy.
- **Protein hormones** Hormones that are proteins or modified amino acids. They have their effect by binding to receptors on the cell membrane, initiating a series of chemical reactions.
- **Sarcomeres** The contractile units of muscle cells.
- **Steroid hormones** Hormones made from cholesterol that bind to receptors inside target cells. The steroid hormone-receptor complex then enters the nucleus where it directly affects gene transcription.
- **Testes** The organs in males in which sperm are made.
- **Uterus** The organ in females where a fertilized egg implants and the embryo develops during pregnancy.

Detailed Chapter Summary

Hormones are molecules that give instructions to the body. Compared to the nervous system, the hormones of the endocrine system generally control activities that take place over longer time scales.

Hormones are produced in one place in the body, released into the blood, and received by target cells elsewhere in the body. Protein hormones bind to receptors in the cell membrane of target cells, initiating a series of chemical reactions. Steroid hormones, which are made from cholesterol, cross the cell membrane and bind to receptors inside target cells. The steroid hormone-receptor complex then binds to DNA in the nucleus and impacts gene transcription.

The hypothalamus, a part of the brain, is the endocrine system's control center. Many of its hormones regulate the anterior pituitary. Hypothalamus hormones are also stored and released by the posterior pituitary, including antidiuretic hormone, which regulates the amount of water in the body, and oxytocin, which stimulates uterine contraction. The anterior pituitary is known as the master gland because many of its hormones regulate other endocrine glands, including the thyroid gland, sex organs, and adrenal glands. The anterior pituitary also makes growth hormone, which promotes growth, and prolactin, which stimulates milk production. The thyroid gland makes thyroid hormones, involved in metabolism, growth, and development, as well as calcitonin, which regulates calcium levels in the blood. The parathyroid gland makes parathyroid hormone, which also helps control calcium levels in the blood. The adrenal glands make epinephrine and norepinephrine, which are involved in the "fight or flight" response. They also make glucocorticoids and mineralocorticoids, which regulate levels of glucose, water, and salt in the body. The pancreas makes insulin and glucagon, which together regulate blood glucose levels. The ovaries and



testes make the sex hormones: estrogens, progesterins, and androgens. The pineal gland produces melatonin, which regulates the body's internal clock. Many of these hormones function in pairs through feedback regulation.

Human reproduction begins with the fertilization of an egg by a sperm. The fertilized egg then develops into a new human during the nine months of pregnancy. Eggs are made in the ovaries and are released during ovulation. Sperm are made in the testes. Sperm must work to penetrate the zona pellucida surrounding the egg before fertilization can occur. Fertilization occurs in the oviduct. Changes in the zona pellucida help insure that only one sperm fertilizes the egg. The fertilized egg implants in the uterus and continues development. The fertilized egg forms the embryo as well as the protective, fluid-filled amnion and the embryonic portion of the placenta. The placenta, which provides oxygen and nutrients to the developing embryo and removes wastes, is made up of both maternal and fetal tissues.

The skeleton includes the bones and cartilages of the body. These function in protection, support, and movement. Joints are movable connections between bones. Bones are made up of multiple layers, including compact bone, spongy bone, and bone marrow. Red bone marrow makes blood cells, and yellow bone marrow stores fats.

Muscles work by contracting. Many of our muscles are found in pairs with opposing effects. A muscle is made up of muscle fibers, each of which is a single long cell. A muscle fiber contains bundles of myofibrils. Each myofibril is made up of a series of sarcomeres. Sarcomeres include filaments of actin and myosin. A sarcomere contracts when the actin and myosin filaments slide past each other, shortening the length of the sarcomere and hence the muscle as a whole.

Muscles contract when they receive signals from motor neurons. These signals produce action potentials in the muscle cells, which cause calcium ions to be released from the endoplasmic reticulum of the muscle cell. Calcium in turn enables myosin heads to bind to actin and pull. The myosin heads continue to release, extend, attach, and pull until the muscle is fully contracted or the signal from the motor neuron stops. ATP is required for the myosin heads to release actin, an essential step in the contraction cycle.

