

Traditionally, the endocrine system has included only organs that secrete chemicals called hormones (also called humors or factors) into the blood or tissue fluids to influence the activity of certain target organs or generate large-scale effects throughout the body. The term "endocrine" means "internal-secreting" (into the blood or tissue fluids) and distinguishes these organs from exocrine glands, which secrete their products into ducts. In recent decades, however, many cases have been discovered of single cells and small groups of cells secreting chemicals with very localized effects, and these are now generally regarded as part of the endocrine system, although they retain their distinctive names.

Color the heading Secretory Types, titles A through D, and the related structures. Use light colors to preserve intracellular detail.

Cells that secrete chemical agents into the tissue fluids or local capillaries to produce an effect some distance away comprise the conventional *endocrine* glands. Secretory cells that release their product directly into adjacent cells or in the surrounding extracellular fluid resulting in a very local effect are called *paracrine* cells. *Synaptic* secretion occurs at a synapse, where the nerve impulse is transferred from the axon of one neuron to the cell body, axon, or dendrite of another neuron. The cells are separated by a small gap, called the synaptic cleft, and the axon releases a chemical, called a neurotransmitter, into that cleft, stimulating the neuron on the other side to initiate, facilitate, or inhibit the formation of a nerve impulse. (It is not unusual for one neuron in the brain or spinal cord to have 10,000 or more synapses.) Hormone-secreting cells whose secretory activity is stimulated directly by nerve endings are called *neurocrine* cells.

Color the heading Endocrine Organs, titles E through N, and the related structures in the illustration at the right. Use contrasting colors for G (light) and H (dark). Only the right adrenal gland is shown.

The brain consists of billions of interconnecting neurons, producing a variety of chemical agents that are essentially hormonal in their chemical structure and their function but are classified as neurotransmitters. In addition, secretory neurons of the hypothalamus, located just above the pituitary gland, secrete neurohormones directly into an adjacent capillary network, which carries them to the anterior pituitary gland just below, inducing or inhib-

iting its secretion of pituitary hormones. Other secretory neurons from the hypothalamus extend into the posterior pituitary gland and release their hormones directly to influence its secretory action.

The *pituitary gland* (hypophysis), connected to the hypothalamus by a stalk, has two major lobes. The anterior lobe is composed of six cell types producing growth and milk-production hormones plus four tropic (stimulatory) hormones influencing the thyroid, adrenal cortex, and reproductive organs. The posterior pituitary produces hormones regulating childbirth, milk release, blood pressure, and the water content of urine.

The *thyroid gland* secretes a hormone important in metabolism and in fetal development. The four pea-sized *parathyroid glands*, embedded in the posterior capsule of the thyroid gland, secrete a pair of hormones necessary for calcium, magnesium, and phosphate metabolism.

The outer part (cortex) of the *adrenal gland* secretes a group of hormones regulating sugar, water, and ionic balance. The inner part (medulla) secretes hormones functioning with the visceral nervous system and is associated with stress reactions.

The *kidneys* also contain endocrine cells that secrete erythropoietin, regulating red blood cell production, and renin, important in water and salt metabolism and therefore blood pressure.

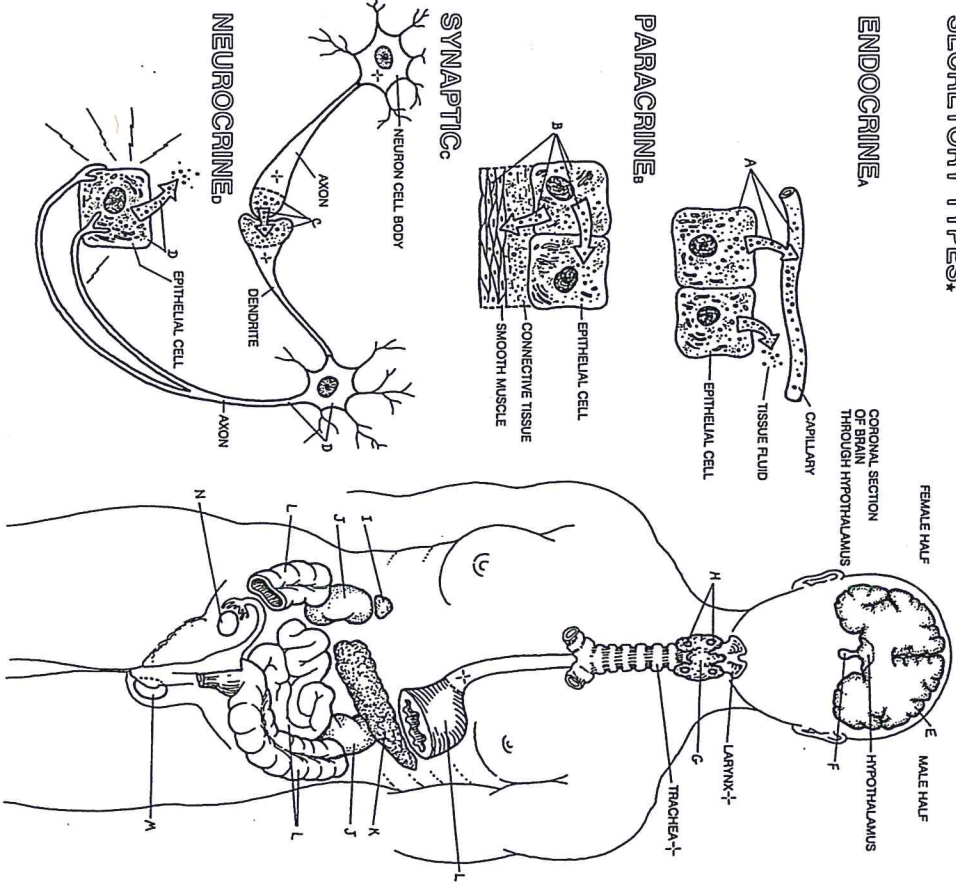
The *pancreas*, suspended in the curve formed by the stomach and duodenum, contains groups (islets) of endocrine cells that secrete four hormones, the best known of which is insulin, essential for the transport of glucose into cells.

The *gastrointestinal tract* can be considered as the largest endocrine organ of the body, with specialized epithelial cells of the mucosa secreting ten or more hormones concerned largely with local stimulus and response activities in the tract. Some of these are neurocrine types, others paracrine or endocrine.

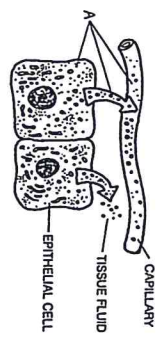
The *ovaries*, largely concerned with the production of sperm cells, contain isolated cell groups (interstitial cells) that secrete the male sex hormone testosterone, important in the development and maintenance of the male sex organs, glands, and ducts.

The *ovary*, concerned with the production of female reproductive cells (ova), produces the female sex hormones estrogen and progesterone. These endocrine secretions influence the development and maintenance of the female sex organs, glands, and ducts and have wider systemic effects as well.

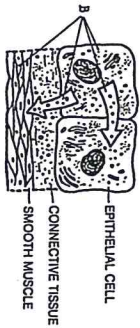
SECRETORY TYPES.



ENDOCRINE

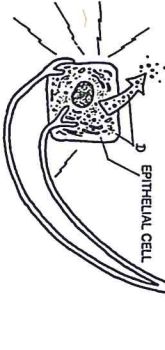


PARACRINE



SYNAPTIC

NEUROCRINE



- ENDOCRINE ORGANS*
- BRAIN
- PITUITARY GLAND
- THYROID GLAND
- PARATHYROID GLAND

- ADRENAL GLAND
- KIDNEY
- PANCREAS
- GASTROINTESTINAL TRACT
- TESTES
- OVARY

ENDOCRINE SYSTEM

 = gland
  = hormone
  = Function
 Name _____

