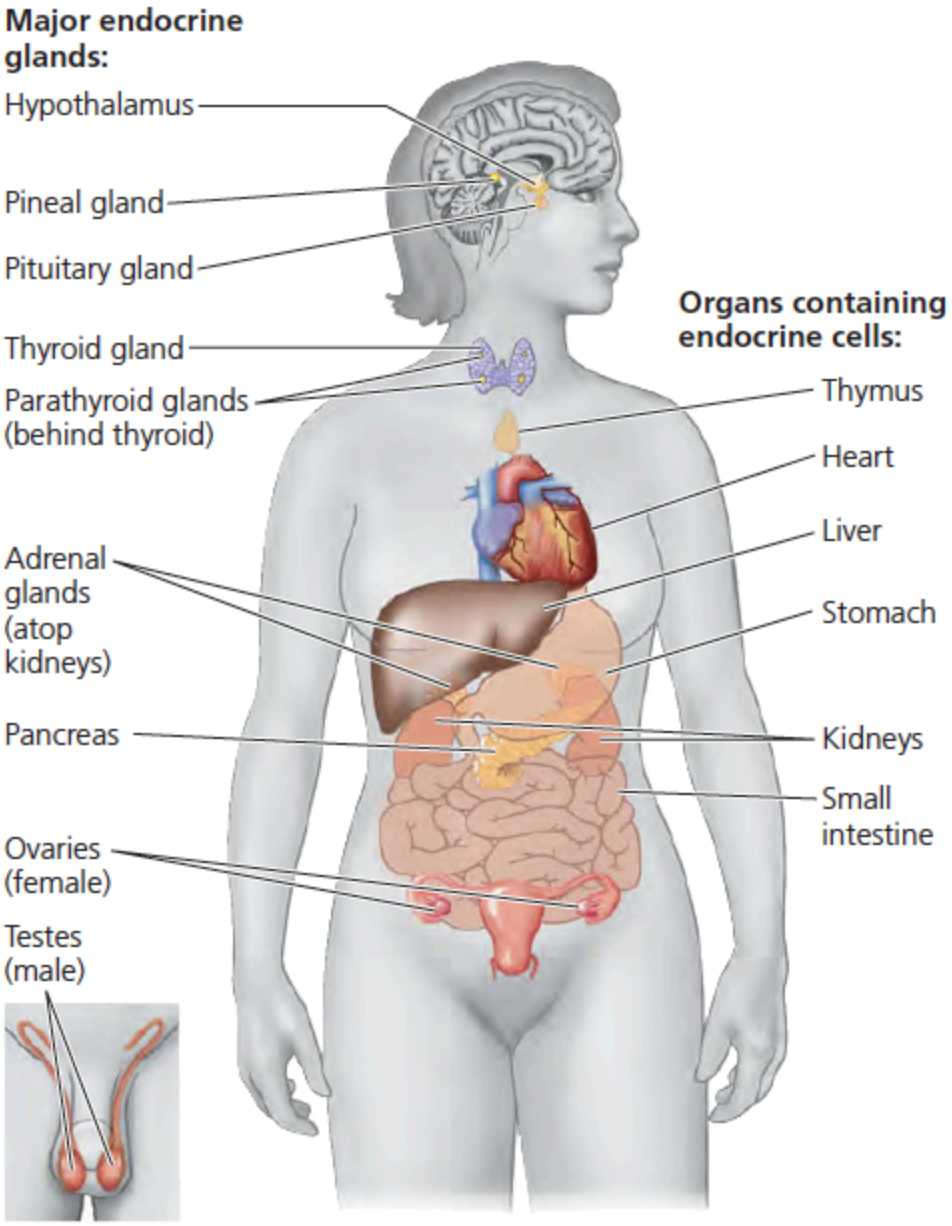
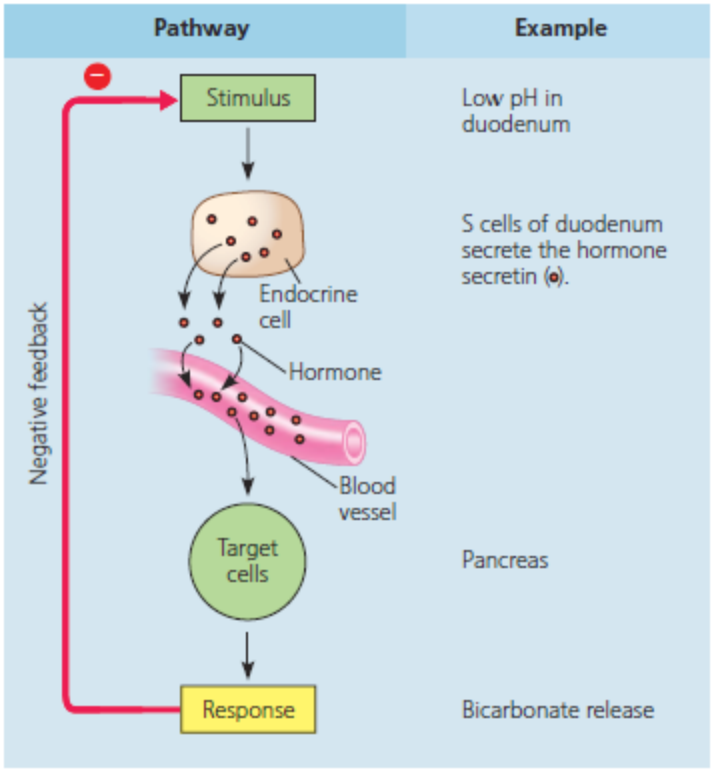
Cheat Sheet



▲ **Figure 45.4** **Major human endocrine glands.**

Table 45.1 Major Human Endocrine Glands and Some of Their Hormones

Gland		Hormone	Chemical Class	Representative Actions	Regulated By
Hypothalamus		Hormones released from the posterior pituitary and hormones that regulate the anterior pituitary (see below)			
Posterior pituitary gland (releases neurohormones made in hypothalamus)		Oxytocin	Peptide	Stimulates contraction of uterus and mammary gland cells	Nervous system
		Antidiuretic hormone (ADH)	Peptide	Promotes retention of water by kidneys	Water/salt balance
Anterior pituitary gland		Growth hormone (GH)	Protein	Stimulates growth (especially bones) and metabolic functions	Hypothalamic hormones
		Prolactin	Protein	Stimulates milk production and secretion	Hypothalamic hormones
		Follicle-stimulating hormone (FSH)	Glycoprotein	Stimulates production of ova and sperm	Hypothalamic hormones
		Luteinizing hormone (LH)	Glycoprotein	Stimulates ovaries and testes	Hypothalamic hormones
		Thyroid-stimulating hormone (TSH)	Glycoprotein	Stimulates thyroid gland	Hypothalamic hormones
		Adrenocorticotropic hormone (ACTH)	Peptide	Stimulates adrenal cortex to secrete glucocorticoids	Hypothalamic hormones
Thyroid gland		Triiodothyronine (T_3) and thyroxine (T_4)	Amines	Stimulate and maintain metabolic processes	TSH
		Calcitonin	Peptide	Lowers blood calcium level	Calcium in blood
Parathyroid glands		Parathyroid hormone (PTH)	Peptide	Raises blood calcium level	Calcium in blood
Pancreas		Insulin	Protein	Lowers blood glucose level	Glucose in blood
		Glucagon	Protein	Raises blood glucose level	Glucose in blood
Adrenal glands					
Adrenal medulla		Epinephrine and norepinephrine	Amines	Raise blood glucose level; increase metabolic activities; constrict certain blood vessels	Nervous system
Adrenal cortex		Glucocorticoids	Steroids	Raise blood glucose level	ACTH
		Mineralocorticoids	Steroids	Promote reabsorption of Na^+ and excretion of K^+ in kidneys	K^+ in blood; angiotensin II
Gonads					
Testes		Androgens	Steroids	Support sperm formation; promote development and maintenance of male secondary sex characteristics	FSH and LH
Ovaries		Estrogens	Steroids	Stimulate uterine lining growth; promote development and maintenance of female secondary sex characteristics	FSH and LH
		Progestins	Steroids	Promote uterine lining growth	FSH and LH
Pineal gland		Melatonin	Amine	Involved in biological rhythms	Light/dark cycles


Pathway
Example
Stimulus
Low pH in duodenum
S cells of duodenum secrete the hormone secretin (⊖).
Endocrine cell
Hormone
Blood vessel
Target cells
Pancreas
Response
Bicarbonate release
Negative feedback

Chapter 45 Questions

1. **What are hormones?**
2. **What are cells that a hormone affects called?**
3. **What is the endocrine system?**
4. **What is the nervous system?**
5. **What is endocrine signaling?**
6. **What are local regulators?**
7. **What is paracrine signaling?**
8. **What is autocrine signaling?**
9. **What are prostaglandins?**
10. **How do aspirin and ibuprofen work?**
11. **What is synaptic signaling?**
12. **What is neuroendocrine signaling?**
13. **Give an example of a neurohormone.**
14. **What are pheromones?**
15. **What are *Leptogenys distinguenda* and *Antheraea polyphemus*?**
16. **What type of local regulator are cytokines?**
17. **What is nitric oxide?**
18. **What are the three major chemical classes of hormones?**
19. **How do signaling pathways differ for hydrophilic and hydrophobic hormones?**
20. **What is signal transduction?**
21. **Describe the epinephrine pathway.**
22. **Describe the estradiol pathway in female birds and frogs.**
23. **What is the difference between lipid-soluble steroid and non-steroid hormones?**
24. **What are endocrine glands?**
25. **What are exocrine glands?**
26. **What two types of tissue does the pancreas have?**
27. **Describe the secretions and locations of the following glands: thyroid, parathyroid, adrenal gland (medulla/cortex), ovaries, testes, hypothalamus, pituitary (posterior/anterior), pancreas, pineal gland.**
28. **What is a simple endocrine pathway?**
29. **Describe the simple endocrine pathway of the duodenum.**
30. **What is a simple neuroendocrine pathway?**
31. **Describe the simple neuroendocrine pathway in nursing mothers.**
32. **What is negative feedback?**
33. **What is positive feedback?**
34. **What is *Hyalophora cecropia*?**
35. **Describe the pathway that controls molting.**
36. **Describe the pathway that controls metamorphosis.**
37. **What is the hypothalamus?**
38. **What is the pituitary gland?**

39. What is the difference between the posterior and anterior pituitary?
40. What two hormones are produced by the posterior pituitary?
41. What are hypothalamic hormones that regulate release of anterior pituitary hormones called?
42. What is prolactin-releasing hormone?
43. How do releasing and inhibiting hormones affect the anterior pituitary?
44. What is a hormone cascade?
45. What are tropic hormones?
46. What is thyroid hormone?
47. Describe the hormone cascade that regulates thyroid hormone release.
48. What can iodine deficiency cause?
49. What is growth hormone?
50. What is the difference between acromegaly and gigantism?
51. What is pituitary dwarfism?
52. What is the danger of low blood Ca^{2+}?
53. What is the danger of high blood Ca^{2+}?
54. What are the parathyroid glands?
55. Describe the effects of PTH.
56. What is calcitonin?
57. What are adrenal glands?
58. What are two hormones of the adrenal medulla?
59. What are catecholamines?
60. How does epinephrine cause many different responses?
61. How is the adrenal cortex activated?
62. What are the two main corticosteroids in humans?
63. What are NSAIDS?
64. What are the principal sources of sex hormones?
65. What are the three major types of steroid sex hormones?
66. What sex hormones do the testes produce?
67. What are anabolic steroids?
68. What are estrogens?
69. What is progesterone?
70. What two hormones control synthesis of sex hormones?
71. What determines the reproductive structures that develop?
72. What is diethylstilbestrol (DES)?
73. What is an endocrine disruptor?
74. What is bisphenol A?
75. What effect can estrogen-like molecules from soybeans/other plant products have?
76. What is melatonin?
77. What role does T_4 have in frogs?
78. What roles does prolactin have in birds, amphibians, and fishes?
79. What is melanocyte-stimulating hormone (MSH)?

80. What is cachexia?

Chapter 45 Answers

1. Signaling molecules secreted into EC fluid, communicate regulatory messages
2. target cells, have corresponding receptor
3. System responsible for chemical signaling by hormones
4. Other major communication/control system, network of neurons that transmit signals
5. Hormones secreted into extracellular fluid by endocrine cells reach target cells by circulating fluid
6. Molecules that act over short distances, reach target by diffusion, act within seconds
7. Target cells lie near secreting cell, signaling by local regulators
8. Secreting cells are the target cells
9. Local regulators: in immune system promote inflammation and sensation of pain, regulate aggregation of platelets. Are modified fatty acids
10. Block prostaglandin synthesis to prevent inflammation and pain, help prevent heart attack by reducing aggregation/blockage of vessels
11. Neurons secrete neurotransmitters that diffuse short distance to bind receptors on target cells at synapses.
12. Neurons called neurosecretory cells secrete neurohormones that diffuse from nerve cell into blood stream.
13. ADH
14. Chemicals released into external environment for communication
15. Asian army ants and polyphemus moth (long-range sex pheromone)
16. Polypeptides
17. Gas, functions as local regulator and neurotransmitter. Causes vasodilation by activating enzyme to relax muscles in response to low blood oxygen (secreted/synthesized by blood vessel walls)
18. Polypeptides (e.g. insulin = two chains), hydrophilic
    Steroids (e.g. cortisol), four fused carbon rings, derived from cholesterol (phobic)
    Amines (e.g. epinephrine (philic) and thyroxine (phobic)), synthesized from single amino acid (Trp or Tyr)
19. Water-soluble travel freely in bloodstream, can't penetrate membrane, interact with cell-surface receptors
    Lipid-soluble diffuse across membranes, bind to transport proteins, diffuse into target cells to bind to receptors in cytoplasm/nucleus. Receptor directly triggers cell's response, response usually change in gene expression.
20. Chain of events that converts extracellular chemical signal into intracellular response
21. When in stressful situation, adrenal glands (above kidneys) secrete epinephrine, which regulates organs by binding to GPCR, triggering synthesis of cAMP and activation of protein kinase A and eventually glycogen breakdown.
22. Estradiol binds cytoplasmic receptor in liver cells, activating transcription of vitellogenin gene. Protein transported to reproductive system, used to produce egg yolk.

23. Steroid hormone receptors usually in cytosol
    Non-steroid (e.g. Thyroxine, vitamin D), have receptors in nucleus, bind molecules that diffuse across plasma membrane and nuclear envelope, receptors stimulate gene transcription
24. Groups of endocrine cells grouped into ductless organs such as thyroid and parathyroid glands
25. Have ducts that carry secreted substances onto body surfaces
26. Endocrine (ductless tissue secreting hormones) and exocrine (ducts, secrete enzymes/bicarbonate)
27. See picture
28. Endocrine cells respond directly to an internal or environmental stimulus by secreting particular hormone.
29. see image
30. Stimulus received by a sensory neuron rather than endocrine tissue. Neuron stimulates neurosecretory cell, which secretes neurohormone
31. Suckling stimulates sensory neurons in nipples, nerve impulses reach hypothalamus, triggers secretion of neurohormone oxytocin from posterior pituitary gland causing contraction of mammary gland cells
32. Response reduces initial stimulus
33. Stimulus is reinforced by response
34. Giant silk moth
35. Neurosecretory cells in brain produce PTTH (polypeptide hormone prothoracicotropic hormone), directs release of hormone ecdysteroid in endocrine organ prothoracic gland. Bursts of ecdysteroid trigger each molt
36. Juvenile hormone secreted by pair of endocrine gland behind brain, modulates ecdysteroid activity. When high, ecdysteroid causes molting, if low ecdysteroid causes pupa formation
37. Coordinates endocrine signaling, receives information from nerves throughout body, initiates neuroendocrine signaling, responsible for response to seasonal changes
38. Gland located at base of hypothalamus, size and shape of lima bean, two fused glands that form posterior/anterior lobes
39. Posterior = extension of hypothalamus (hypothalamic axons in posterior secrete neurohormones from hypothalamus)
    Anterior = endocrine gland that synthesizes/secretes hormones in response to hypothalamic hormones
40. ADH (vasopressin) regulates kidney function, has role in social behavior
    Oxytocin controls milk secretion/regulates uterine contractions at birth, influences behaviors related to maternal care, pair bonding, sexual activity
41. Releasing (at least one per anterior pituitary hormone) or inhibiting hormones
42. Hypothalamic hormone that stimulates anterior pituitary to secrete prolactin (stimulates milk production, also has inhibiting hormone)
43. Secreted into capillaries at base of hypothalamus that drain into portal vessels that subdivide into capillary bed within anterior pituitary

44. Form of regulation in which multiple endocrine organs/signals act in series.
45. Hormones that act as an intermediate (e.g. FSH/LH (gonadotropins) convey signals from hypothalamus to gonads, but released from anterior pituitary)
46. Regulates bioenergetics in mammals, helps maintain normal blood pressure/heart rate/muscle tone, regulates digestive/reproductive functions. pair of similar molecules derived from tyrosine (triiodothyronine (T_3) has 3 iodine, tetraiodothyronine (thyroxine, T_4) has 4, only molecules with iodine synthesized in body)
47. Thyrotropin releasing hormone (TRH) released by hypothalamus in response to low thyroid hormone levels, anterior pituitary releases thyrotropin (aka thyroid stimulating hormone, TSH) that stimulates thyroid gland in neck (two lobes on ventral surface of trachea) to secrete thyroid hormone
48. Not enough thyroid hormone, more TSH, causes thyroid gland to enlarge, resulting in goiter (swelling of neck)
49. Secreted by anterior pituitary, stimulates growth, targets liver (releases insulin-like growth factors, IGFs that circulate in blood and stimulate bone/cartilage growth), tends to raise blood glucose levels, skeleton requires GH to grow
50. If hypersecretion of GH occurs in childhood, gigantism occurs (normal body proportions) If in adulthood, only few body parts responsive to GH (face, hands, feet), causing acromegaly (overgrowth of extremities)
51. Dwarfism caused by hyposecretion of GH in childhood, proper proportions, short
52. Skeletal muscles begin to contract convulsively
53. Calcium phosphate can form precipitates in body tissues = organ damage
54. Set of four structures embedded in posterior of thyroid, play role in Ca^{2+} regulation. When level falls below 10 mg/100 mL, glands release parathyroid hormone (PTH), has direct effects in bones/kidneys, indirect on intestines
55. In bones, causes mineralized matrix to break down to release Ca^{2+}. In kidneys, stimulates reabsorption of Ca^{2+}. Promotes production of vitamin D (precursor form obtained from food/sunlight, converted in liver) in kidney to stimulate completion of conversion, vitamin D acts on intestines, stimulates uptake of Ca^{2+} from food
56. Hormone that inhibits bone breakdown, enhances Ca^{2+} excretion in kidneys, released by thyroid gland, required in fishes/rodents for homeostasis, only required in humans for childhood bone growth
57. Located atop kidneys, respond to stress, made up of two glands.
    Cortex = outer portion, true endocrine, medulla = inner portion, develops from neural tissue
58. Epinephrine (adrenaline) and norepinephrine (noradrenaline) cause fight or flight response. Increase immediately available chemical energy, increase rate of glycogen breakdown in liver/muscles, promote release of glucose by liver and fatty acids by fat cells.
59. Class of amine hormones synthesized from tyrosine (e.g. epinephrine and norepinephrine), increase heart rate and stroke volume, dilate bronchioles in lungs, alter blood flow (constrict some vessels, dilate others to shunt blood to heart,brain,muscles)

60. In liver cells, binds to ß-type receptors that activates protein kinase A
    In smooth muscle cells to skeletal muscles, same kinase, same receptor, inactivates muscle specific enzyme causing relaxation
    In smooth muscle of intestines, binds α-type receptor, triggers different pathway to bring about vasoconstriction
61. Stressful conditions stimulate hypothalamus to secrete stimulating hormone that causes anterior pituitary to release adrenocorticotropic hormone (ACTH) that stimulates cortex to synthesize/secrete steroids called corticosteroids
62. Glucocorticoids (e.g. cortisol), make more glucose available, promote glucose synthesis from noncarb sources, cause breakdown of skeletal muscle proteins into amino acids to be converted to glucose. In excess, suppress certain parts of immune system. Mineralocorticoids maintain salt/water balance (aldosterone functions in ion and water homeostasis of blood), participate in homeostatic regulation of metabolism
63. Nonsteroidal anti-inflammatory drugs (e.g. aspirin/ibuprofen) better for treating arthritis since don't have metabolic side effects
64. gonads
65. Androgens, estrogens, and progesterone
66. Primarily androgens (mainly testosterone, functions before birth, promotes development of male reproductive structures, causes dev of secondary characteristics during puberty such as lengthening/thickening of vocal cords, hair growth pattern, more muscle mass)
67. Muscle-building, can cause severe acne outbreaks and liver damage, decreases sperm count and testicular size
68. Responsible for maintenance of female reproductive system (most important is estradiol)
69. In mammals involved in preparing/maintaining tissues of uterus required to support growth of embryo
70. Gonadotropins of anterior pituitary (follicle-stimulating and luteinizing hormone) whose secretion is controlled by GnRH (gonadotropin releasing hormone) from hypothalamus.
71. Gonads start bipotential, have male duct (Wolffian) and female duct (Mullerian),Testosterone and anti-Mullerian hormone (AMH) cause degeneration of female ducts and male reproductive parts
72. Synthetic estrogen to help pregnant women at risk for complication, found to alter reproductive system development of fetus, now known endocrine disruptor
73. Foreign molecule that interrupts normal function of a hormone pathway
74. Chemical in plastics, studied for interference with reproduction
75. Can lower risk of breast cancer
76. Modified amino acid that regulates functions related to light and seasons, produced by pineal gland (mass of tissue near center of brain), can affect skin pigmentation, mainly effects biological rhythms. Secreted at night, amount released depends on night length, secretion controlled by group of hypothalamic neurons called suprachiasmatic nucleus (SCN), acts as biological clock, receives input from neurons in retina of eye
77. Stimulates resorption of tadpole's tail during metamorphosis
78. Regulates fat metabolism and reproduction in birds, delays metamorphosis in amphibians, regulates salt/water balance in fishes

79. Secreted by anterior pituitary, regulates skin color by controlling pigment distribution in melanocytes (skin cells). In mammals, functions in hunger and metabolism
80. Wasting condition of patients with late-stage cancer, AIDS, etc. = Weight loss, mmuscle atrophy, loss of appetite. May be caused by activation of brain receptor for MSH