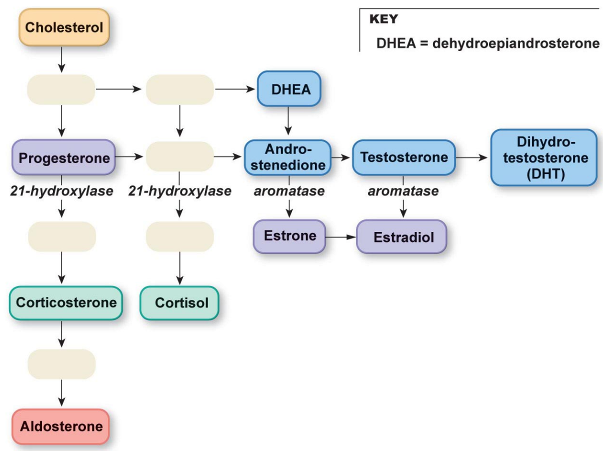


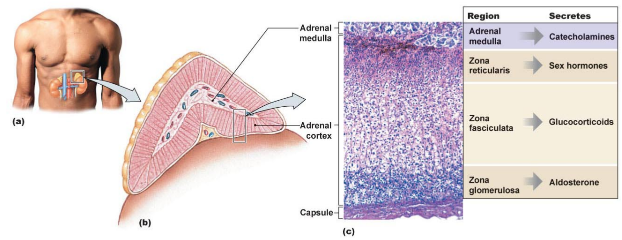
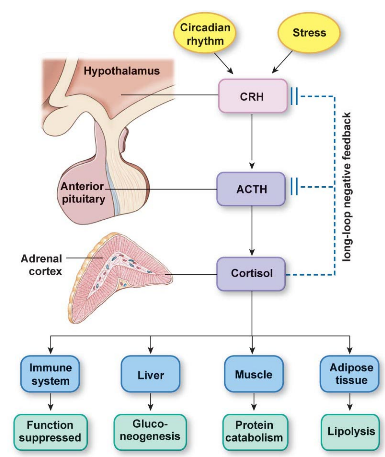
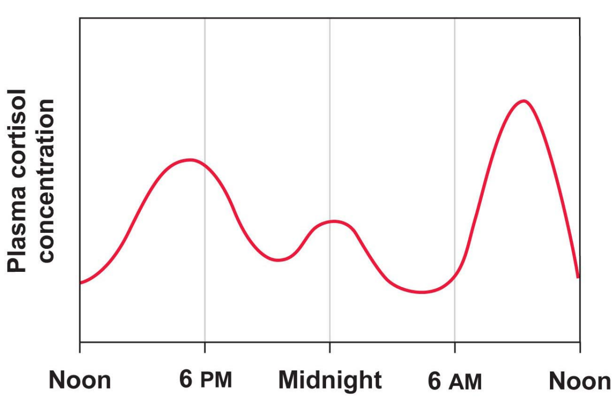
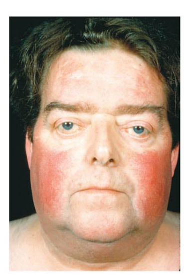


TABLE 23-1	Cortisol
Origin	Adrenal cortex
Chemical nature	Steroid
Biosynthesis	From cholesterol; made on demand, not stored
Transport in the circulation	On corticosteroid-binding globulin (made in liver)
Half-life	60–90 minutes
Factors affecting release	Circadian rhythm of tonic secretion; stress enhances release
Control pathway	CRH (hypothalamus) → ACTH (anterior pituitary) → cortisol (adrenal cortex)
Target cells or tissues	Most tissues
Target receptor	Intracellular
Whole body or tissue action	↑ Plasma [glucose]; ↓ immune activity; permissive for glucagon and catechol-amines
Action at cellular level	↑ Gluconeogenesis and glycogenolysis; ↑ protein catabolism. Blocks cytokine production by immune cells
Action at molecular level	Initiates transcription, translation, and new protein synthesis
Feedback regulation	Negative feedback to anterior pituitary and hypothalamus

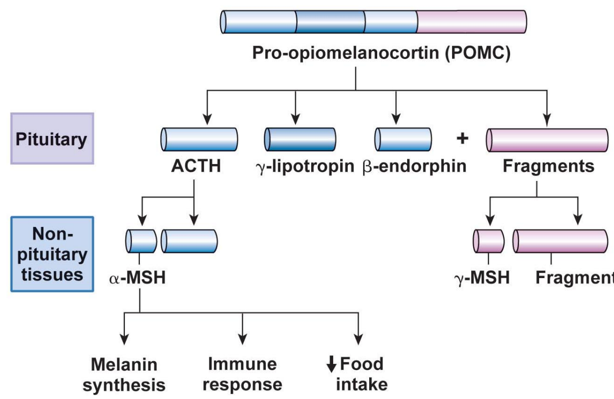


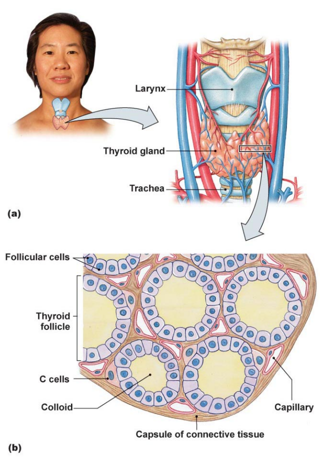


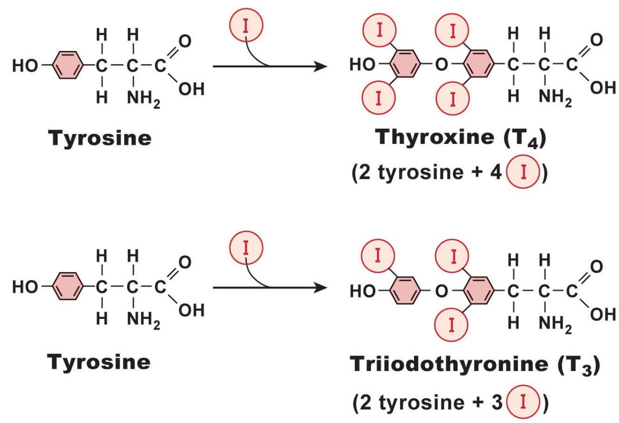

(a) Moon face

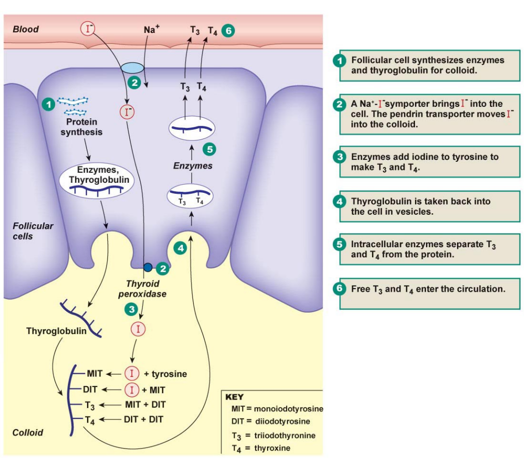

(b) Abdominal fat with striations

TABLE 23-2	Thyroid Hormones
Cell of origin	Thyroid follicle cells
Chemical nature	Iodinated amine
Biosynthesis	From iodine and tyrosine. Formed and stored on thyroglobulin in follicle colloid
Transport in the circulation	Bound to thyroxine-binding globulin and albumins
Half-life	6–7 days for thyroxine (T_4); about 1 day for triiodothyronine (T_3)
Factors affecting release	Tonic release
Control pathway	TRH (hypothalamus) → TSH (anterior pituitary) → T_3 + T_4 (thyroid) → T_4 deiodinates in tissues to form more T_3
Target cells or tissues	Most cells of the body
Target receptor	Nuclear receptor
Whole body or tissue action	↑ Oxygen consumption (thermogenesis). Protein catabolism in adults but anabolism in children. Normal development of nervous system
Action at cellular level	Increases activity of metabolic enzymes and Na^+-K^+-ATPase
Action at molecular level	Production of new enzymes
Feedback regulation	T_3 has negative feedback effect on anterior pituitary and hypothalamus

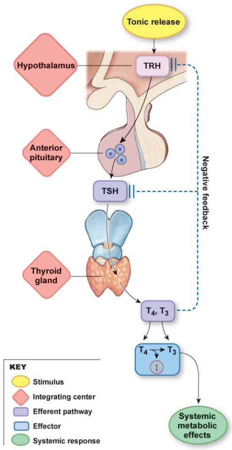


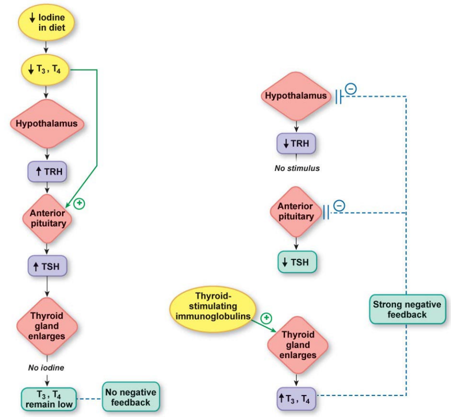






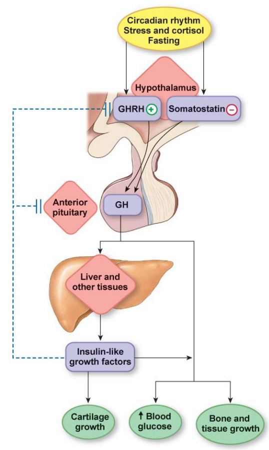
(a) Myxedema (b) Goiter (c) Exophthalmos

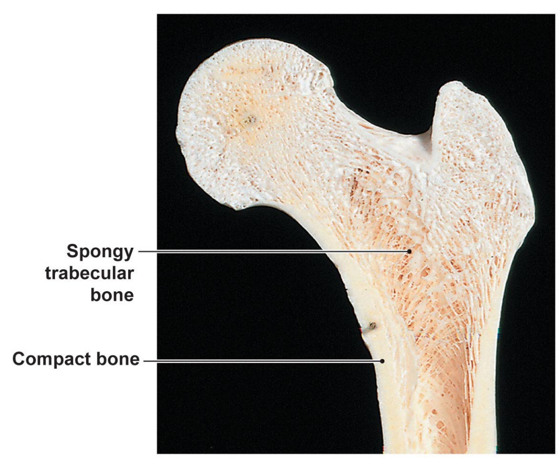




(a) Hypothyroidism due to low iodine (b) Hyperthyroidism due to Graves' disease

TABLE 23-3	Growth Hormone (hGH)
Origin	Anterior pituitary
Chemical nature	191-amino acid peptide; several closely related forms
Biosynthesis	Typical peptide
Transport in the circulation	Half is dissolved in plasma, half is bound to a binding protein whose structure is identical to that of the GH receptor
Half-life	18 minutes
Factors affecting release	Circadian rhythm of tonic secretion; influenced by circulating nutrients, stress, and other hormones in a complex fashion
Target cells or tissues	Trophic on liver for insulin-like growth factor production; also acts directly on many cells
Control pathway	GHRH, somatostatin (hypothalamus) → growth hormone (anterior pituitary)
Target receptor	Membrane receptor with tyrosine kinase activity
Whole body or tissue action (with IGFs)	Bone and cartilage growth; soft tissue growth; ↑ plasma glucose
Action at cellular level	Receptor linked to kinases that phosphorylate proteins to initiate transcription





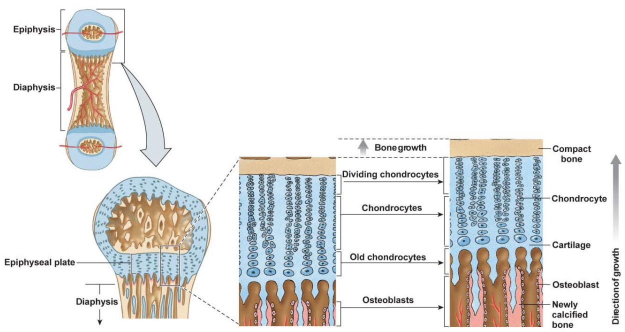


TABLE 23-4 Functions of Calcium in the Body

COMPARTMENT	PERCENTAGE OF BODY CALCIUM	FUNCTION
Extracellular matrix	99%	Calcified matrix of bone
Extracellular fluid	0.1%	"Cement" for tight junctions; role in myocardial and smooth muscle contraction; neurotransmitter release at synapses; role in excitability of neurons; cofactor in coagulation cascade
Intracellular	0.9%	Signal in second messenger pathways; role in muscle contraction

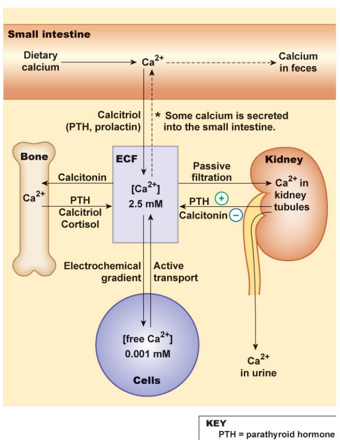
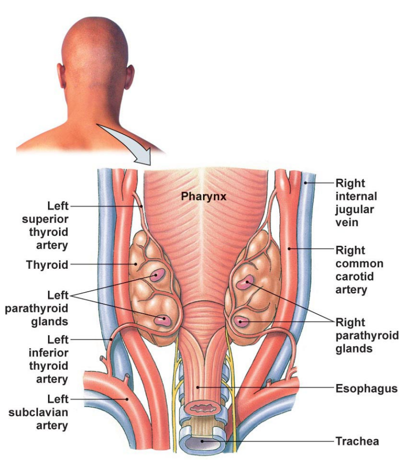


TABLE 23-5 Parathyroid Hormone (PTH)

Cell of origin	Parathyroid glands
Chemical nature	84-amino acid peptide
Biosynthesis	Continuous production, little stored
Transport in the circulation	Dissolved in plasma
Half-life	Less than 20 minutes
Factors affecting release	↓ Plasma Ca^{2+}
Target cells or tissues	Kidney, bone, intestine
Target receptor	Membrane receptor acts via cAMP
Whole body or tissue action	↑ Plasma Ca^{2+}
Action at cellular level	↑ Vitamin D synthesis; ↑ renal reabsorption of Ca^{2+}; ↑ bone resorption
Action at molecular level	Rapidly alters Ca^{2+} transport but also initiates protein synthesis in osteoclasts
Onset of action	2–3 hours for bone, with increased osteoclast activity requiring 1–2 hours. 1–2 days for intestinal absorption. Within minutes for kidney transport
Feedback regulation	Negative feedback by ↑ plasma Ca^{2+}
Other information	Osteoclasts have no PTH receptors and are regulated by PTH-induced paracrines. PTH is essential for life; absence causes hypocalcemic tetany



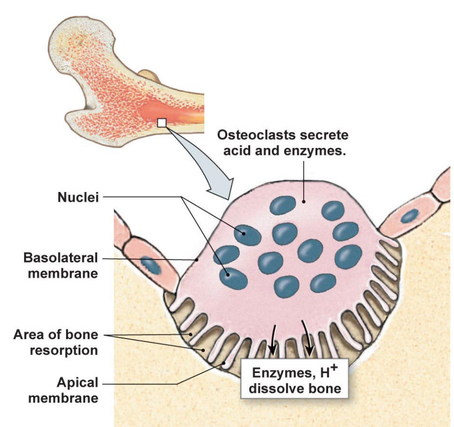


TABLE 23-6	Vitamin D_3 (Calcitriol, 1,25-Dihydroxycholecalciferol)
Cell of origin	Complex biosynthesis; see below
Chemical nature	Steroid
Biosynthesis	Vitamin D formed by sunlight on precursor molecules or ingested in food; converted in two steps (liver and kidney) to $1,25(OH)_2D_3$
Transport in the circulation	Bound to plasma proteins
Stimulus for synthesis	↓ Ca^{2+}. Indirectly via PTH. Prolactin also stimulates synthesis
Target cells or tissues	Intestine, bone, and kidney
Target receptor	Nuclear
Whole body or tissue action	↑ Plasma Ca^{2+}
Action at molecular level	Stimulates production of calbindin, a Ca^{2+}-binding protein, and of CaSR in parathyroid gland. Associated with intestinal transport by unknown mechanism
Feedback regulation	Plasma Ca^{2+} shuts off PTH secretion

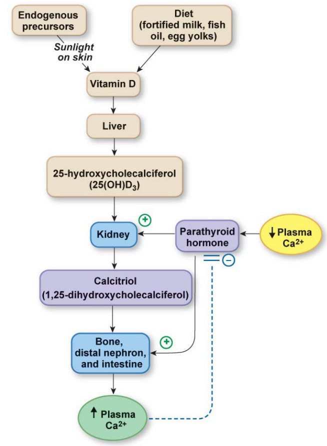


TABLE 23-7	Calcitonin
Cell of origin	C cells of thyroid gland (parafollicular cells)
Chemical nature	32-amino acid peptide
Biosynthesis	Typical peptide
Transport in the cirulation	Dissolved in plasma
Half-life	<10 minutes
Factors affecting release	↑ Plasma [Ca^{2+}]
Target cells or tissues	Bone and kidney
Target receptor	G protein–coupled membrane receptor
Whole body or tissue action	Prevents bone resorption. Enhances kidney excretion
Action at molecular level	Signal transduction pathways appear to vary during cell cycle
Other information	Experimentally decreases plasma [Ca^{2+}] but has little apparent physiological effect in adult humans. Possible effect on skeletal development; possible protection of bone Ca^{2+} stores during pregnancy and lactation