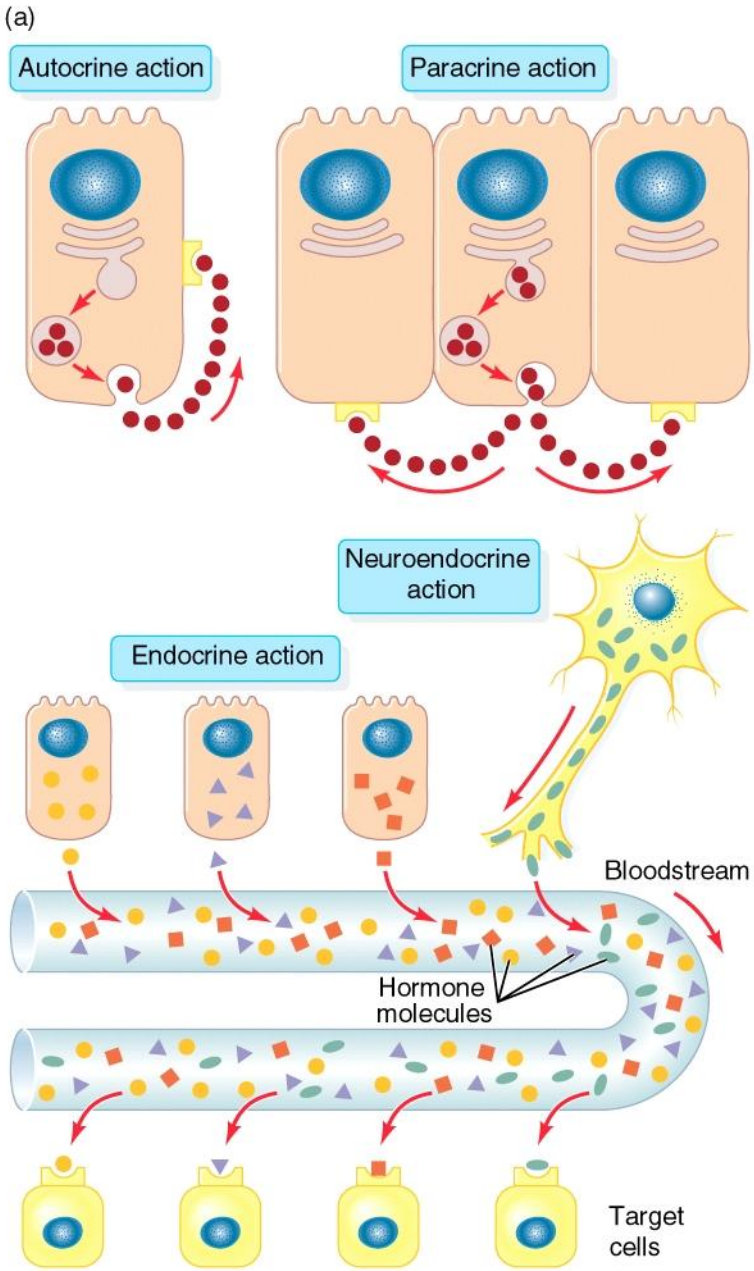
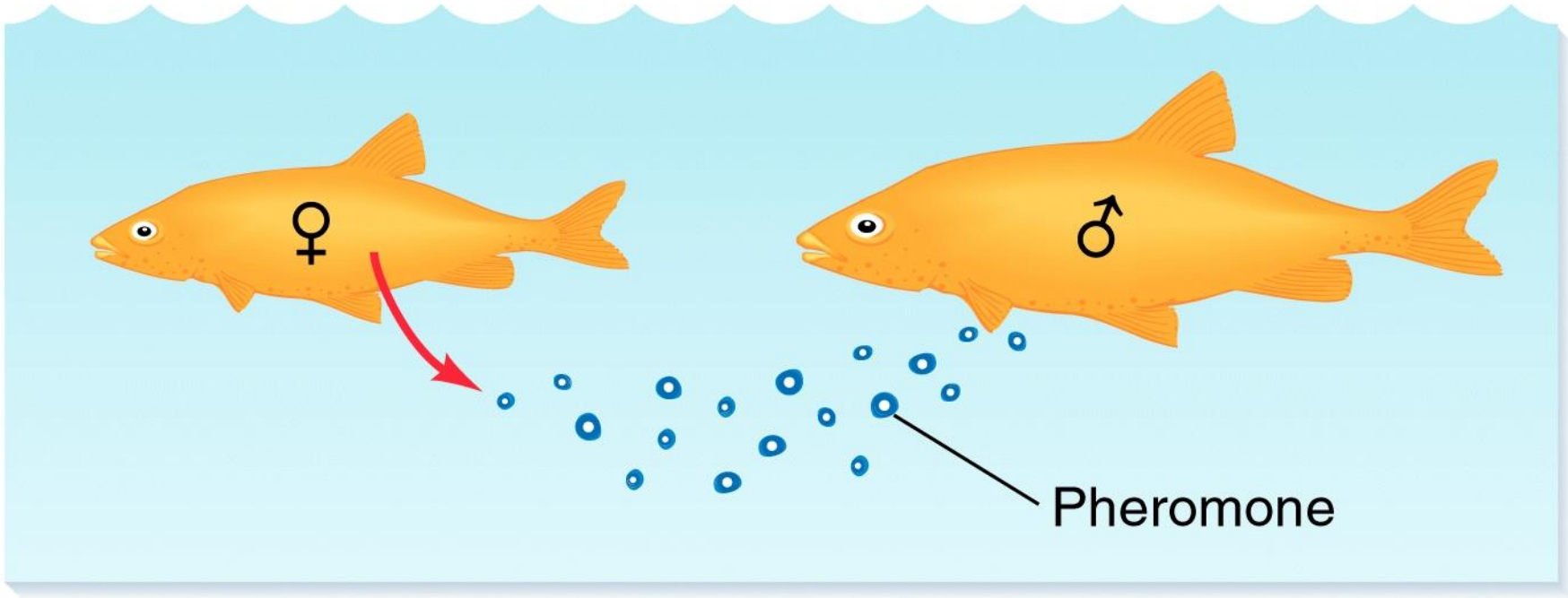
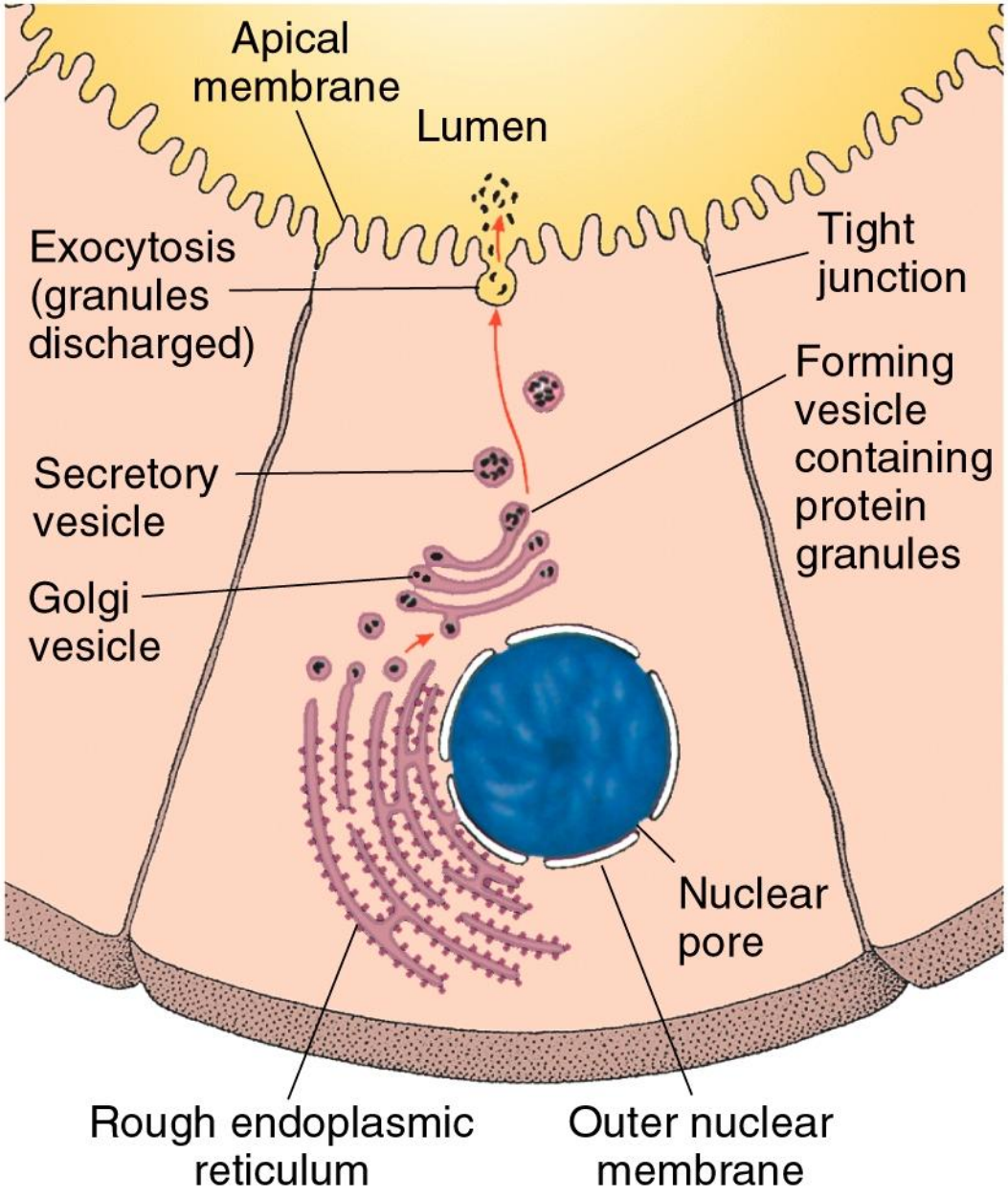
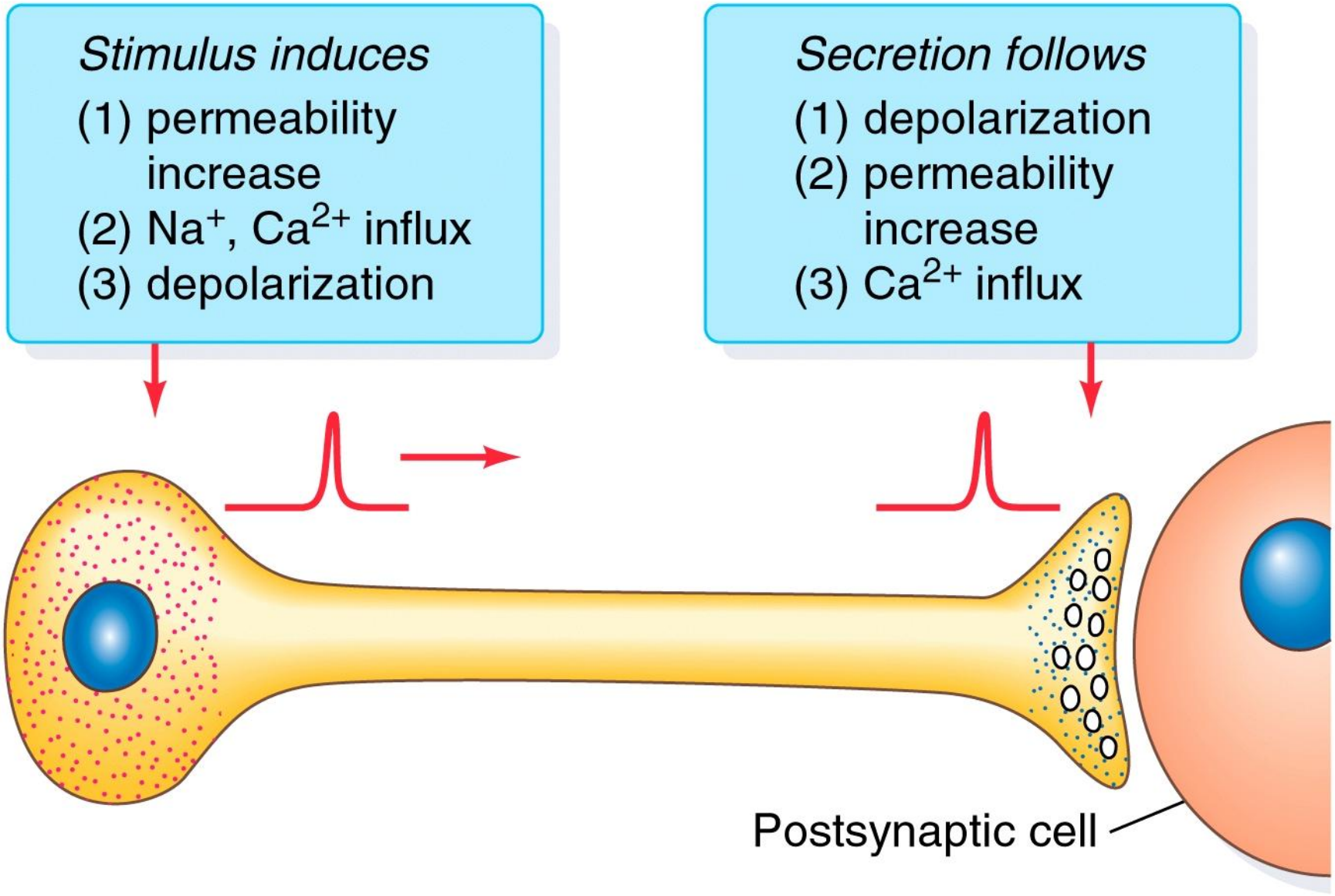

(a)
Autocrine action
Paracrine action
Neuroendocrine action
Endocrine action
Bloodstream
Hormone molecules
Target cells

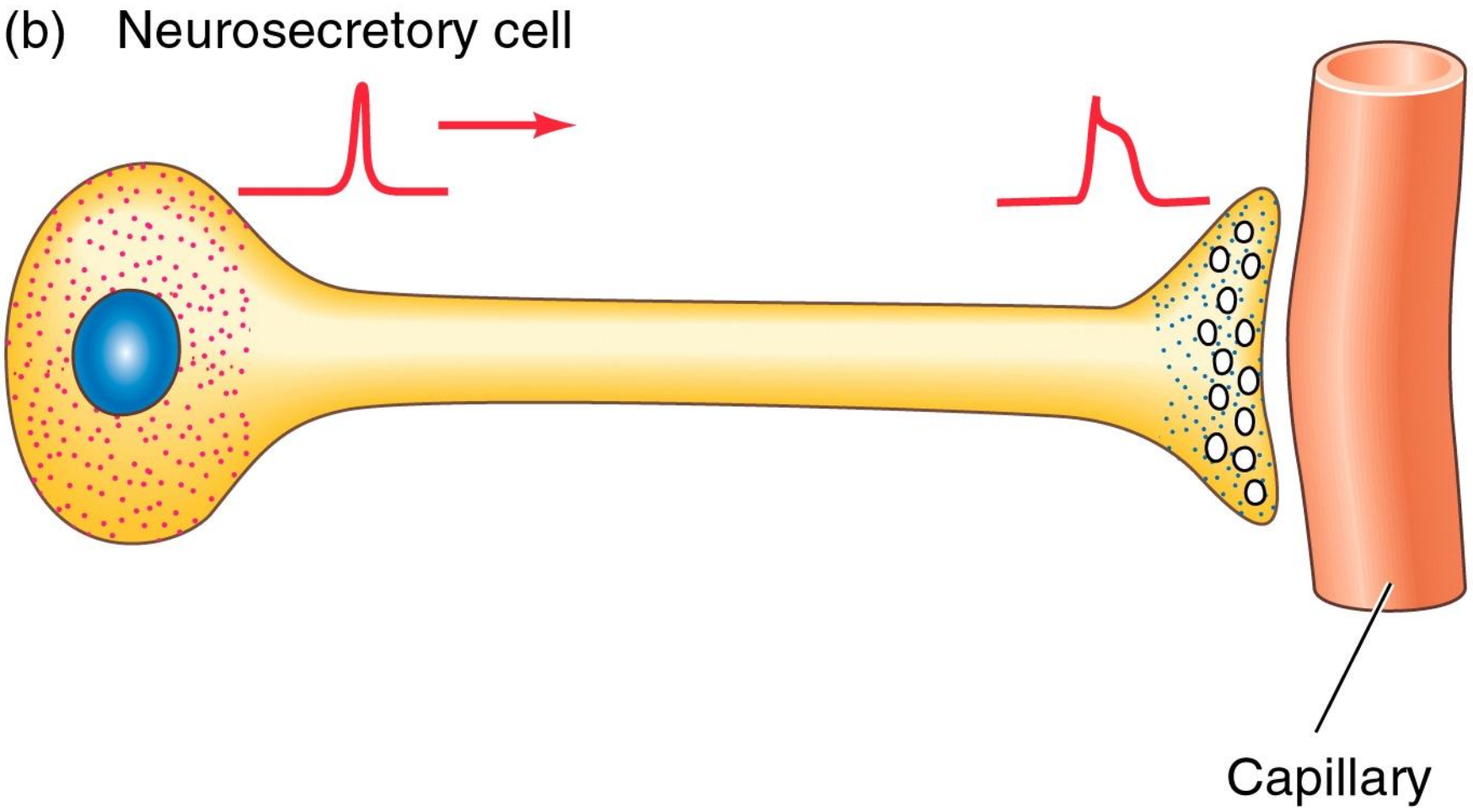
(b)



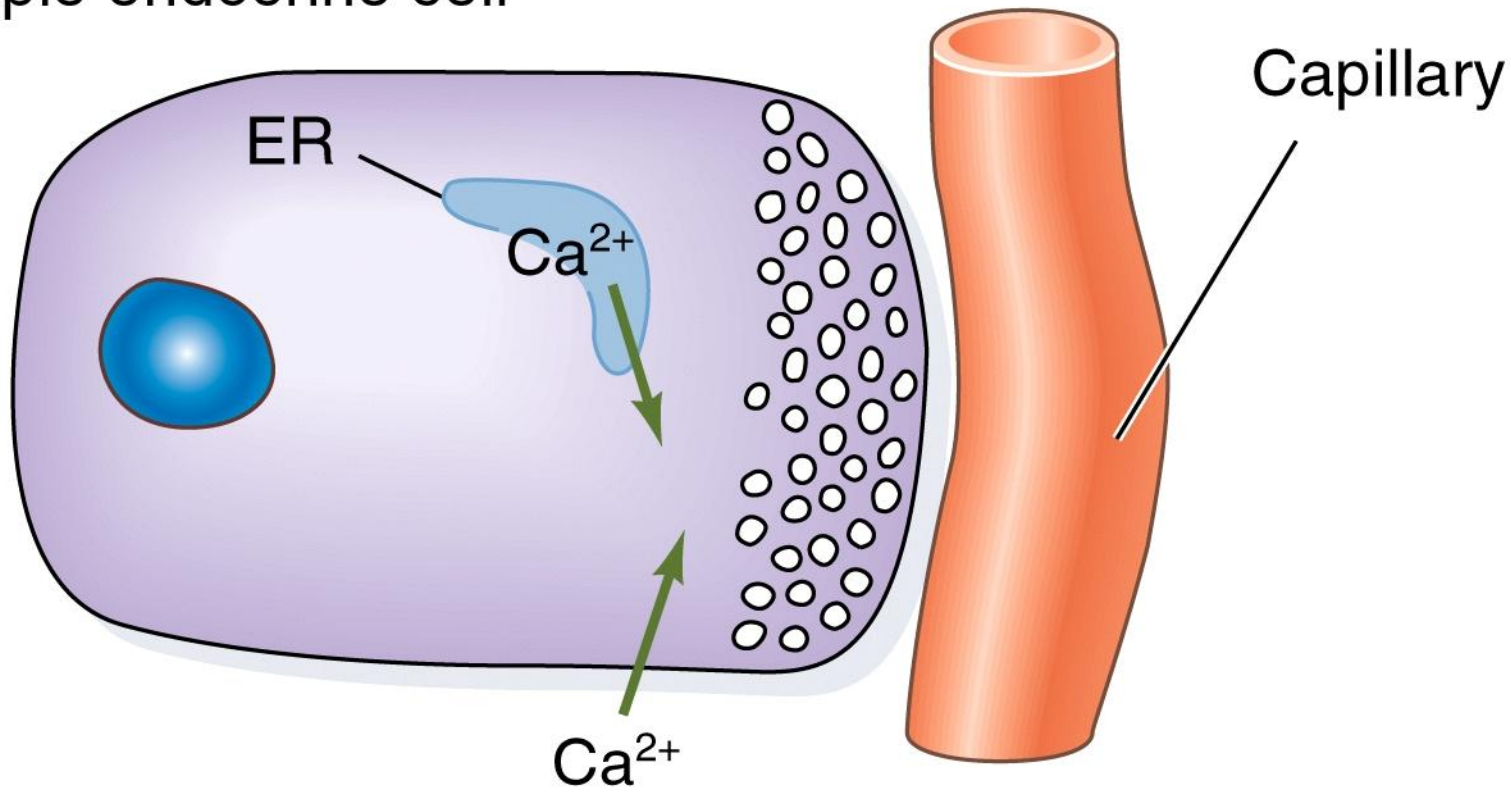

Apical membrane
Lumen
Exocytosis (granules discharged)
Tight junction
Forming vesicle containing protein granules
Secretory vesicle
Golgi vesicle
Nuclear pore
Rough endoplasmic reticulum
Outer nuclear membrane

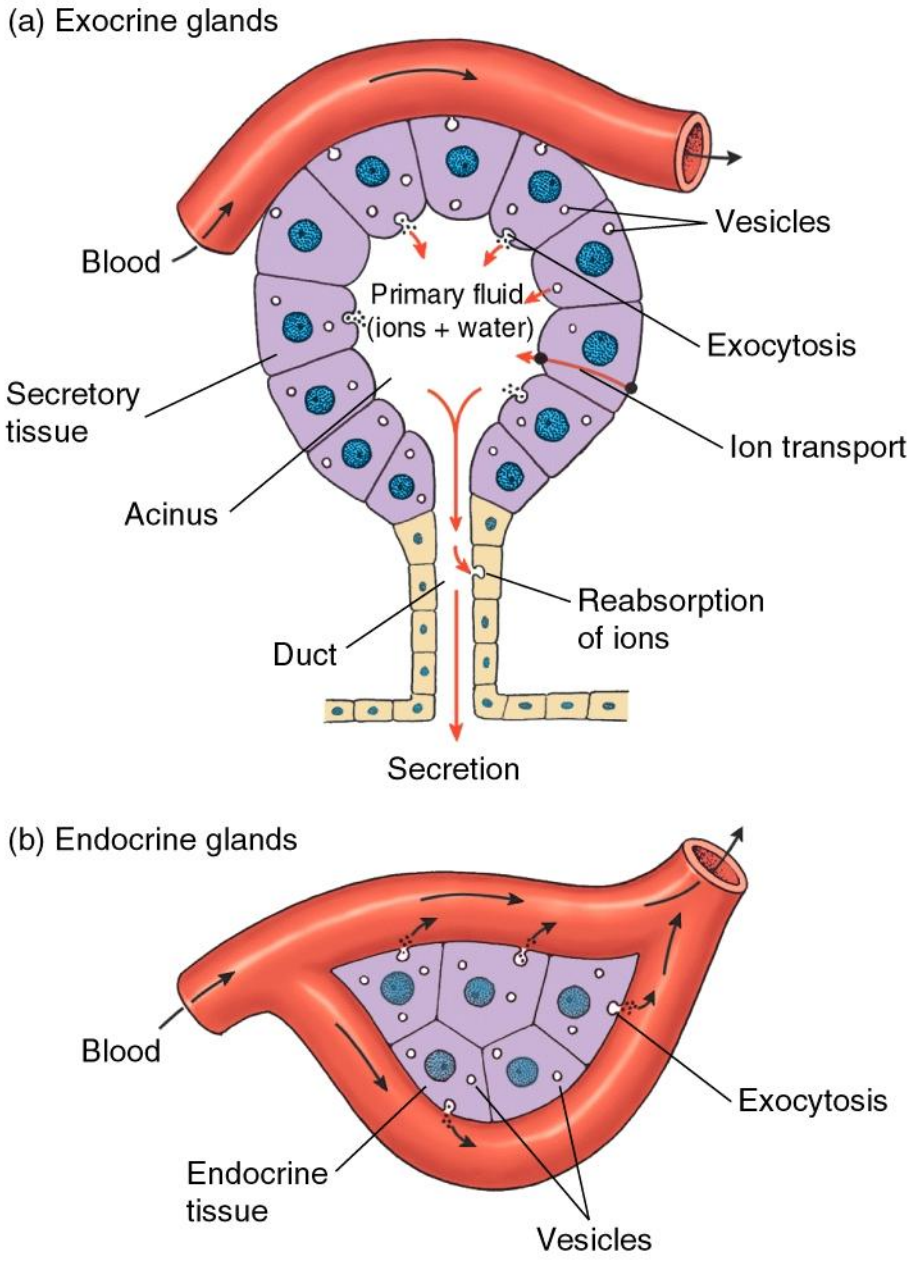
(a) Neuron

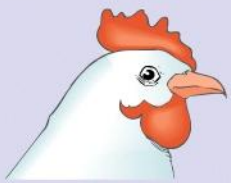
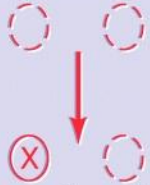

Stimulus induces
(1) permeability increase
(2) Na^+, Ca^{2+} influx
(3) depolarization
Secretion follows
(1) depolarization
(2) permeability increase
(3) Ca^{2+} influx
Postsynaptic cell

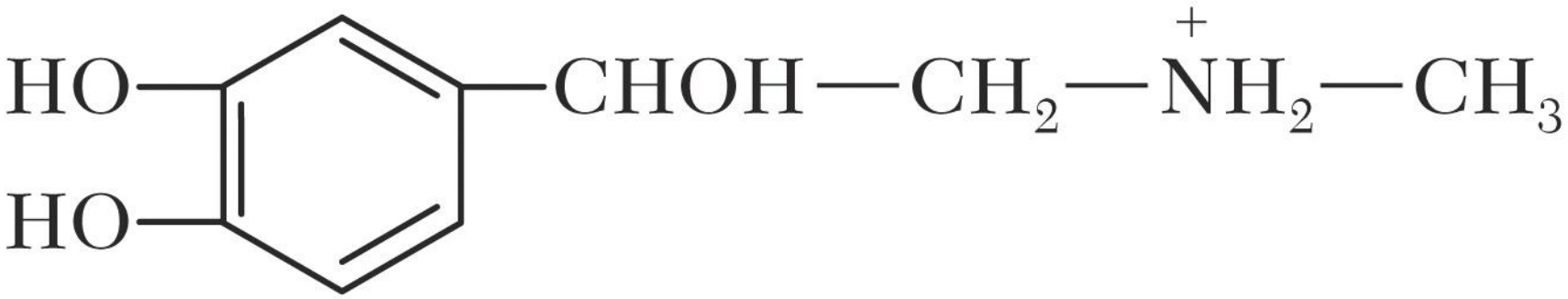

(b) Neurosecretory cell
Capillary

(c) Simple endocrine cell

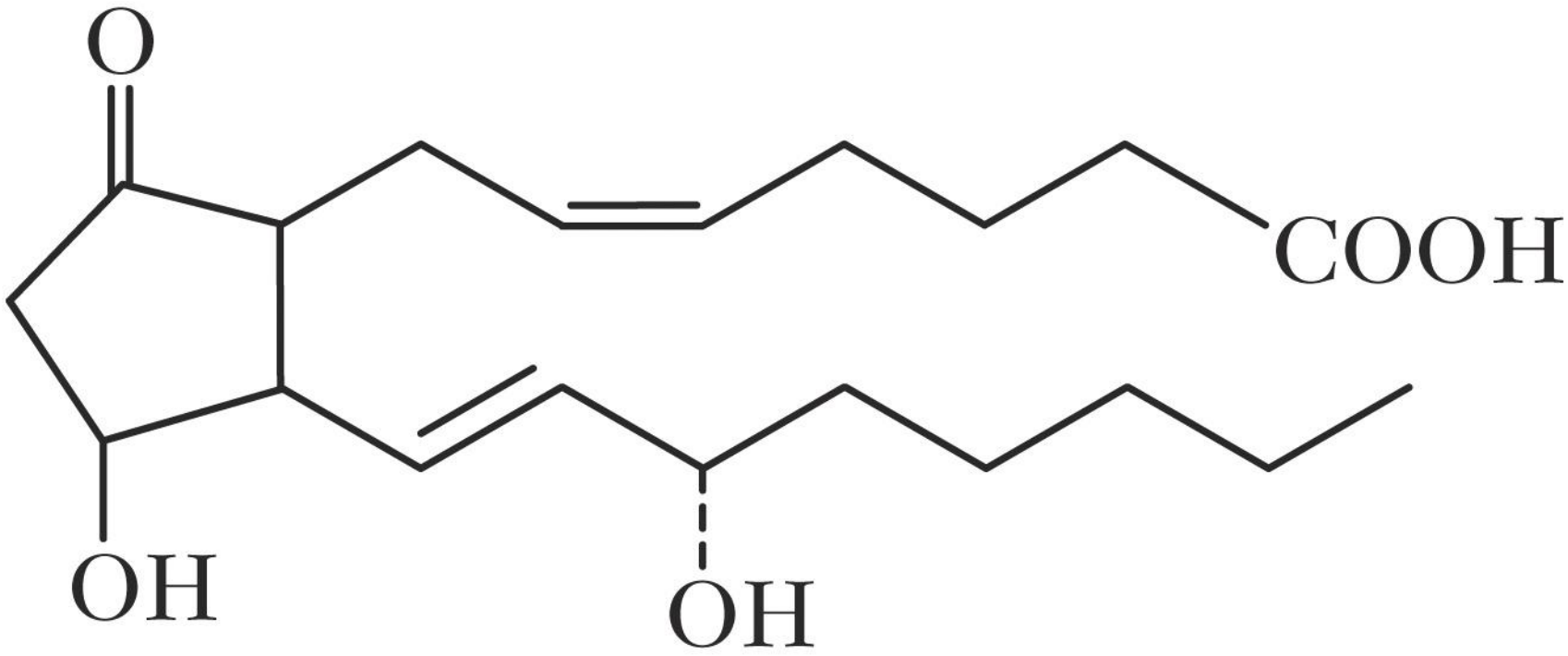



(a) Exocrine glands
Blood
Vesicles
Primary fluid
(ions + water)
Exocytosis
Secretory
tissue
Ion transport
Acinus
Reabsorption
of ions
Duct
Secretion
(b) Endocrine glands
Blood
Exocytosis
Endocrine
tissue
Vesicles

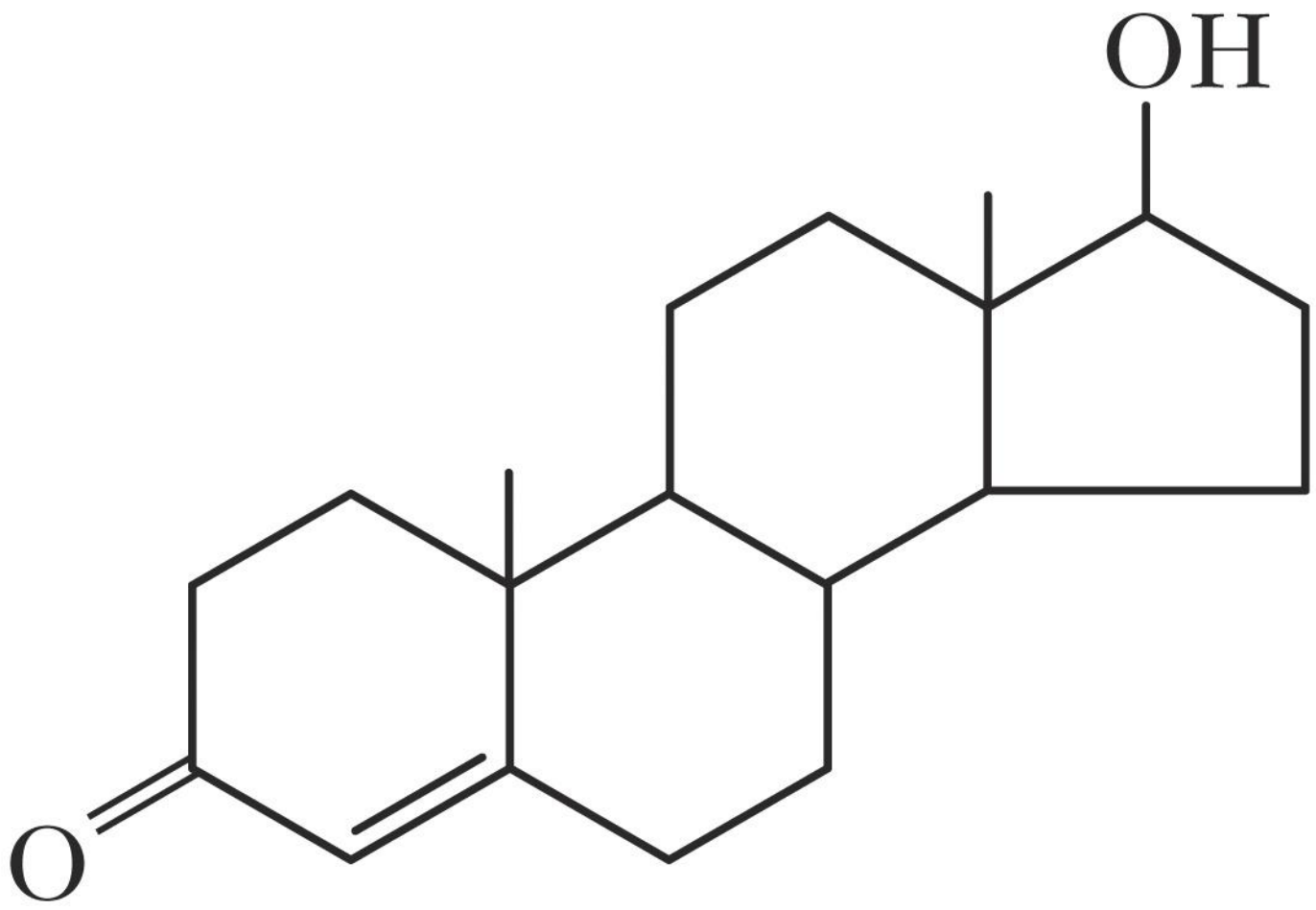
	1	2
Experimental groups	 Normal cock	 Castrated cock
Treatment	 Both testes removed	 One testis replaced
Results	 Comb and wattles small No interest in hens Weak crow Listless fight behavior	 Comb and wattles normal Interest in hens Normal crow Aggressive fight behavior Testis larger than in controls



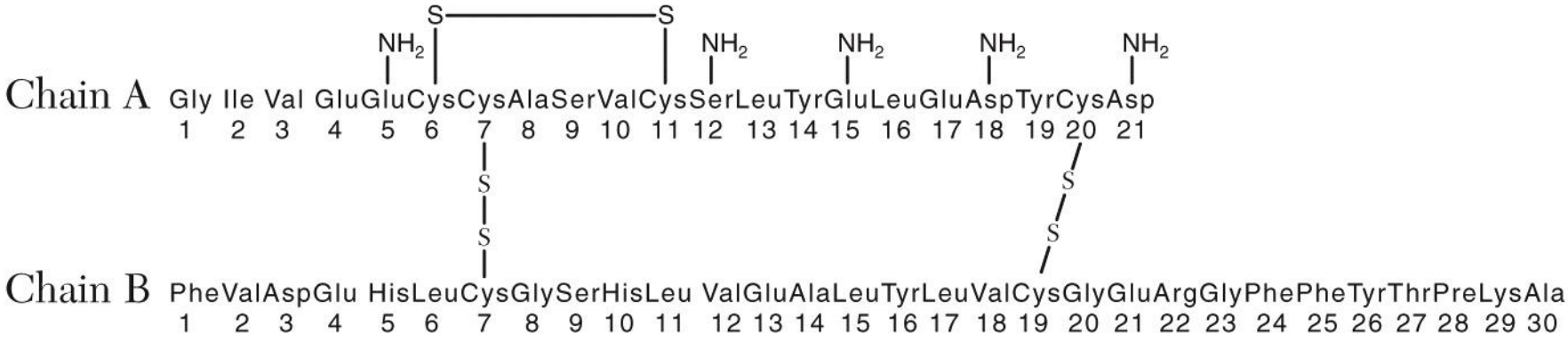
Epinephrine
(an amine)



Prostaglandin PGE_2
(an eicosanoid)



Testosterone
(a steroid)



Insulin (bovine)
(a peptide)

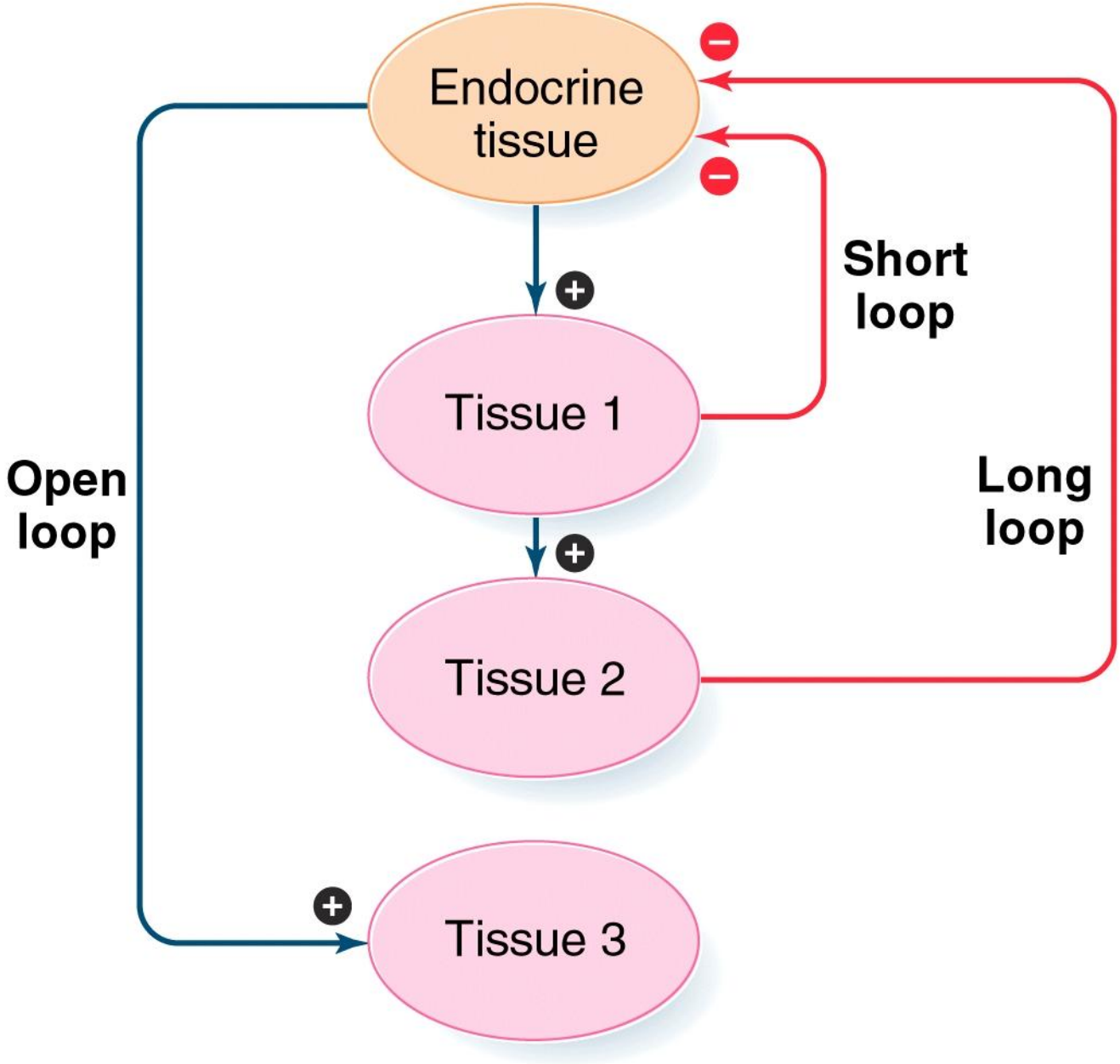

Endocrine tissue
Tissue 1
Tissue 2
Tissue 3
Short loop
Long loop
Open loop

Table 9-1a Vertebrate endocrine glands and tissues

Gland/source	Hormone	Major physiological role*
Adrenal gland		
Steroidogenic tissue (cortex)	Aldosterone	↑ Sodium retention
	Cortisol and corticosterone	↑ Carbohydrate metabolism and sympathetic function
Chromaffin tissue (medulla)	Epinephrine and norepinephrine	Multiple ↑ and ↓ effects on nerves, muscles, cellular secretions, and metabolism
Gastrointestinal tract	Cholecystokinin	↑ Secretion of enzymes by pancreatic acinar cell; ↑ gallbladder contraction
	Chymodenin	↑ Secretion of chymotrypsinogen from the exocrine pancreas
	Gastric inhibitory peptide	↓ Gastric acid (HCI) secretion
	Gastrin	↑ Gastric acid (HCI) secretion
	Gastrin-releasing peptide	↑ Gastrin secretion; ↓ gastric acid (HCI) secretion
	Motilin	↑ Gastric acid secretion and motility of intestinal villi
	Neurotensin	Enteric neurotransmitter
	Secretin	↑ Bicarbonate secretion by pancreatic acinar cells
	Substance P	Enteric neurotransmitter
	Vasoactive intestinal peptide	↑ Intestinal secretion of electrolytes

(continued on the next page)

GASTRIN-releasing peptide increases Gastric acid and HCl production

https://step1.medbullets.com/gastrointestinal/106036/gastric-secretion

Table 9-1b **Vertebrate endocrine glands and tissues**

Gland/source	Hormone	Major physiological role*
Heart (atrium)	Atrial natriuretic peptide (ANP)	↑ Salt and water excretion by kidney
Kidney	Calcitriol†	↑ Blood Ca^{2+}, bone formation, and intestinal absorption of Ca^{2+} and PO_4^{23}
	Erythropoietin (erythrocyte-stimulating factor)	↑ Production of red blood cells (erythropoiesis)
	Renin	↑ Conversion of angiotensinogen to angiotensin II
Ovary		
Preluteal follicle	Estradiol	↑ Female sexual development and behavior
	Estrogen	↑ Estrus and female secondary sexual characteristics; prepares reproductive system for fertilization and ovum implantation
Corpus luteum	Progesterone	↑ Growth of uterine lining and mammary glands, and maternal behavior
	Relaxin	↑ Relaxation of pubic symphysis and dilation of uterine cervix

(continued on the next page)

Table 9-1c Vertebrate endocrine glands and tissues

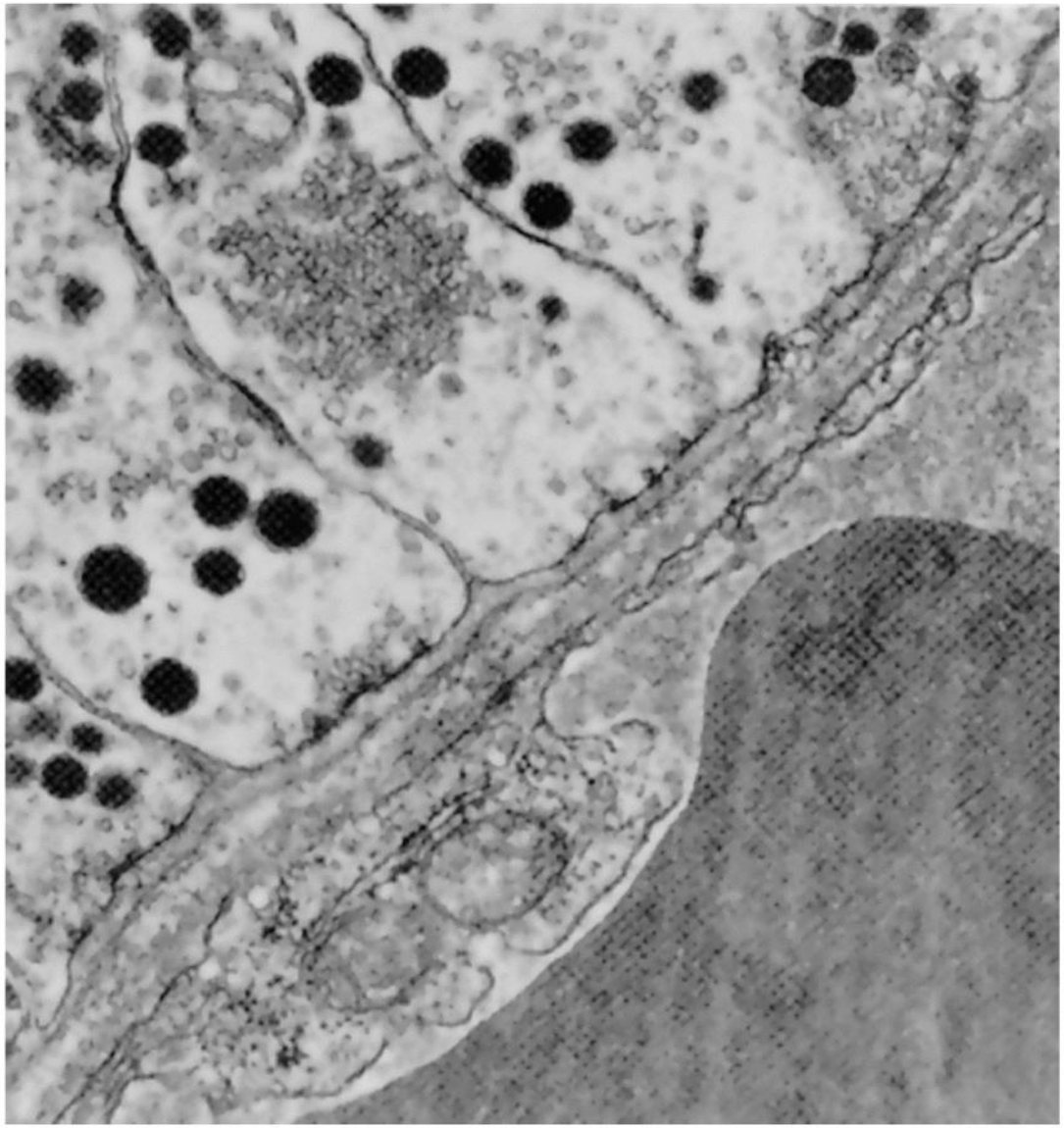
Gland/source	Hormone	Major physiological role*
Pancreas (islets of Langerhans)	Glucagon	↑ Blood glucose, gluconeogenesis, and glycogenolysis
	Insulin	↓ Blood glucose; ↑ protein, glycogen, and fat synthesis
	Pancreatic polypeptide	↑ ↓ Secretion of other pancreatic islet hormones
	Somatostatin	↓ Secretion of other pancreatic islets hormones
Parathyroid glands	Parathormone	↑ Blood Ca^{2+}; ↓ blood PO_4^{-3}
Pineal (epiphysis)	Melatonin	↓ Gonadal development (antigonadotropic action)
Pituitary gland	See Table 9-2, 9-3	
Placenta	Chorionic gonadotropin (CG, choriogonadotropin)	↑ Progesterone synthesis by corpus luteum
	Placental lactogen	↑ Fetal growth and development (possibly); ↑ Mammary gland development in the mother
Plasma angiotensinogen‡	Angiotensin II	↑ Vasoconstriction and aldosterone secretion; ↑ Thirst and fluid ingestion (dipsogenic behavior)
Testes		
Leydig cells	Testosterone	↑ Male sexual development and behavior
Sertoli cells	Inhibin	↓ Pituitary FSH secretion
	Müllerian regression factor	↑ Müllerian duct regression (atrophy)

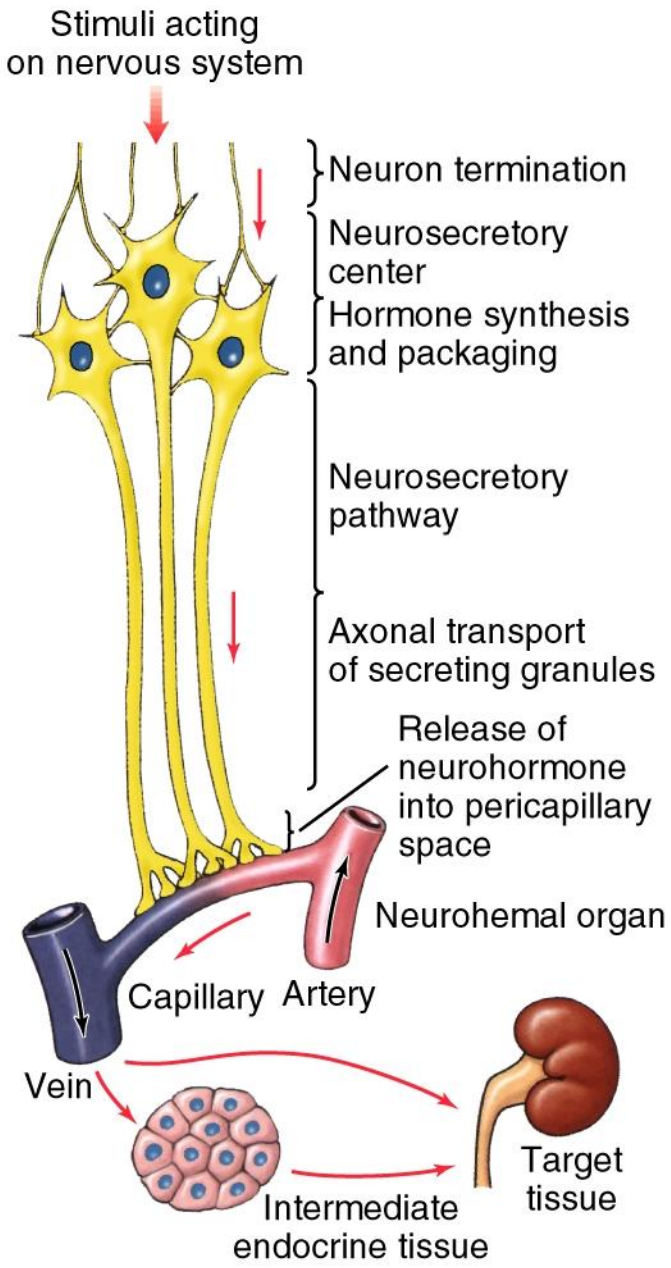
(continued on the next page)

Table 9-1d Vertebrate endocrine glands and tissues

Gland/source	Hormone	Major physiological role*
Thymus gland	Thymic hormones	↑ Proliferation and differentiation of lymphocytes
Thyroid gland		
Follicular cells	Thyroxine and triiodothyronine	↑ Growth and differentiation; ↑ metabolic rate and oxygen consumption (calorigenesis)
Parafollicular cells (or ultimobranchial glands)	Calcitonin	↓ Blood Ca^{2+}
Most or all tissues	Leukotrienes	↑ ↓ Cyclic nucleotide formation
	Prostacyclins	↑ Cyclic nucleotide (cAMP) formation
	Prostaglandins	↑ Cyclic nucleotide (cAMP) formation
	Thromboxanes	↑ Cyclic nucleotide (cGMP?) formation
Selected tissues	Endorphins	Opiate-like activity
	Epidermal growth factor	↑ Epidermal cell proliferation
	Fibroblast growth factor	↑ Fibroblast proliferation
	Nerve growth factor	↑ Neurite development
	Somatomedins	↑ Cellular growth and proliferation

* ↑ means hormone stimulates or increases indicated effect; ↓ means hormone inhibits or decreases indicated effect.
† The final steps in synthesis of calcitriol from vitamin D_3 occur in the kidney, but the skin and liver also play a role in its synthesis.
‡ Angiotensinogen is produced in the liver and circulates in the bloodstream, where it is cleaved by renin to form the active hormone angiotensin II.
Source: Adapted from Hadley, 2000.


2 μm


Stimuli acting
on nervous system
Neuron termination
Neurosecretory
center
Hormone synthesis
and packaging
Neurosecretory
pathway
Axonal transport
of secreting granules
Release of
neurohormone
into pericapillary
space
Neurohemal organ
Capillary
Artery
Vein
Target
tissue
Intermediate
endocrine tissue

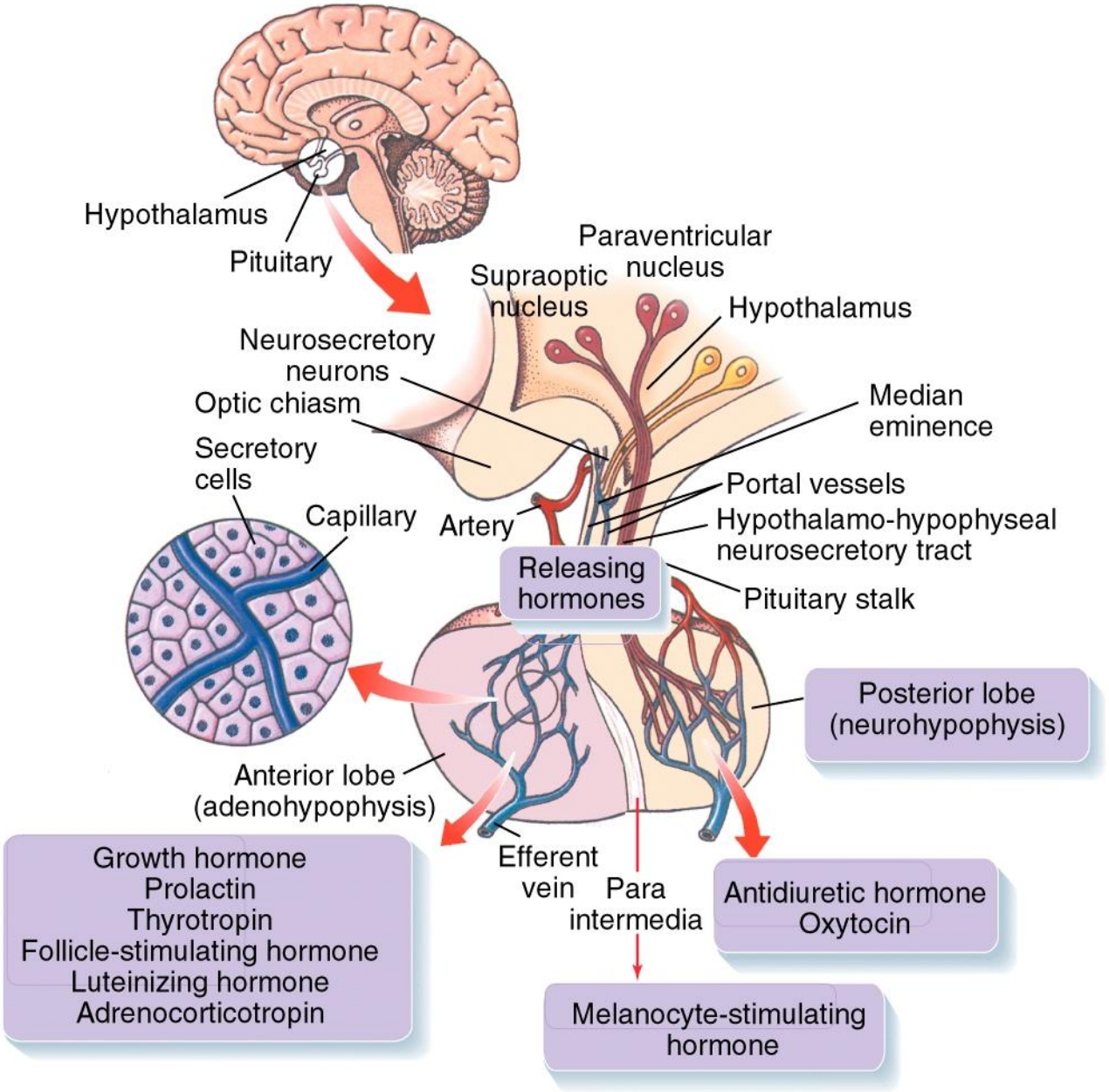

Hypothalamus
Pituitary
Paraventricular nucleus
Supraoptic nucleus
Hypothalamus
Neurosecretory neurons
Optic chiasm
Median eminence
Secretory cells
Capillary
Artery
Portal vessels
Hypothalamo-hypophyseal neurosecretory tract
Releasing hormones
Pituitary stalk
Posterior lobe (neurohypophysis)
Anterior lobe (adenohypophysis)
Efferent vein
Para intermedia
Growth hormone
Prolactin
Thyrotropin
Follicle-stimulating hormone
Luteinizing hormone
Adrenocorticotropin
Antidiuretic hormone
Oxytocin
Melanocyte-stimulating hormone

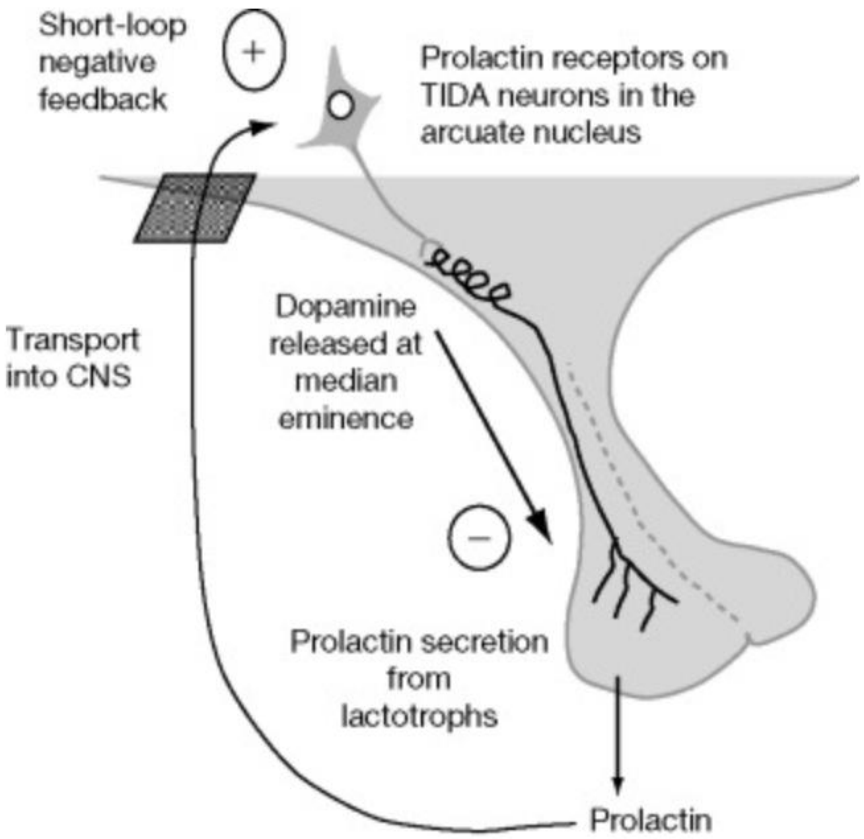
Table 9-2 **Hypothalamic neurohormones that stimulate or inhibit release of adenohypophyseal hormones**

Hormone	Structure	Primary action in mammals	Regulation*
Stimulatory			
Corticotropin-releasing hormone (CRH)	Peptide	Stimulates ACTH release	Stressful neuronal input increases secretion; ACTH inhibits secretion
GH-releasing hormone (GRH)	Peptide	Stimulates GH release	Hypoglycemia stimulates secretion
Gonadotropin-releasing hormone (GnRH)	Peptide	Stimulates release of FSH and LH	In male, low blood testosterone levels stimulate secretion; in female, neuronal input and decreased estrogen levels stimulate secretion; high blood FSH or LH inhibits secretion
TSH-releasing hormone (TRH)	Peptide	Stimulates TSH release and prolactin release	Low body temperatures induce secretion; thyroid hormone inhibits secretion
Inhibitory			
MSH-inhibiting hormone (MIH)	Peptide	Inhibits MSH release	Melatonin stimulates secretion
Prolactin-inhibiting hormone (PIH)	Amine	Inhibits prolactin release	High levels of prolactin increase secretion; estrogen, testosterone, and neuronal stimuli (suckling) inhibit secretion
Somatostatin (GH-inhibiting hormone, GIH)	Peptide	Inhibits release of GH and many other hormones (e.g., TSH, insulin, glucagon)	Exercise induces secretion; hormone is rapidly inactivated in body tissues

*ACTH = adrenocorticotropic hormone; FSH = follicle-stimulating hormone; GH = growth hormone; LH = luteinizing hormone; MSH = melanocyte-stimulating hormone; TSH = thyroid-stimulating hormone.

Considerable evidence now exists that dopamine is a physiological prolactin inhibiting factor (PIF); however, it may not represent the only PIF.

Clemens JA, Shaar CJ, Smalstig EB. Dopamine, PIF, and other regulators of prolactin secretion. Fed Proc. 1980 Sep;39(11):2907-11. PMID: 6105975.



Review > Neurosci Biobehav Rev. 2002 Jan;26(1):31-44. doi: 10.1016/s0149-7634(01)00036-7.

Orgasm-induced prolactin secretion: feedback control of sexual drive?

Tillmann H C Krüger [1], Philip Haake, Uwe Hartmann, Manfred Schedlowski, Michael S Exton

Affiliations + expand

PMID: 11835982 DOI: 10.1016/s0149-7634(01)00036-7

Abstract

Recent studies from our laboratory have investigated the hormonal response to various forms of sexual stimulation, including film, masturbation, and coitus in both men and women. This series of studies clearly demonstrated that plasma prolactin (PRL) concentrations are substantially increased for over 1h following orgasm (masturbation and coitus conditions) in both men and women, but unchanged following sexual arousal without orgasm. Here we discuss evidence suggesting that the PRL response to orgasm may play an important role in the control of acute sexual arousal following orgasm. Supporting this position, chronic elevations of PRL (hyperprolactinemia) produce pronounced reductions in animal sexual activity, and significant reduction of libido and gonadal function in both men and women. These data suggest that PRL may represent a peripheral regulatory factor for reproductive function, and/or a feedback mechanism that signals CNS centres controlling sexual arousal and behaviour. Thus, we propose a theoretical model of the role of PRL as a neuroendocrine reproductive reflex.

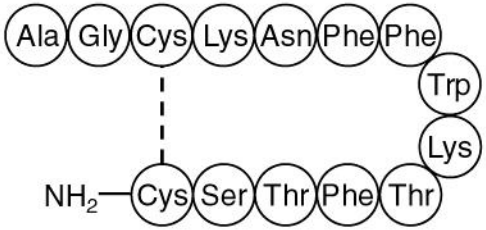
TSH-releasing hormone

Glu–His–Pro–NH_2

Gonadotropin-releasing hormone

Glu–His–Trp–Ser–Tyr–Gly–Leu–Arg–Pro–Gly–NH_2

Somatostatin



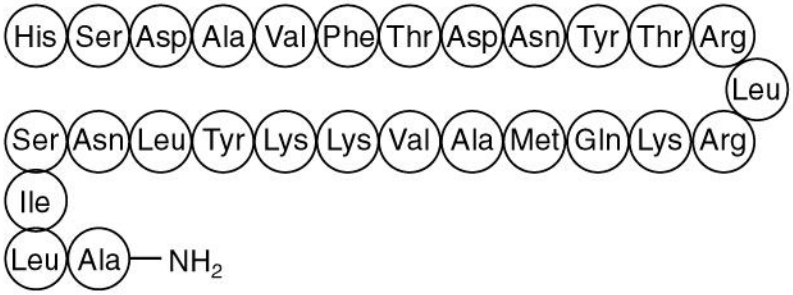
Leu-enkephalin

Tyr–Gly–Gly–Phe–Leu–NH_2

Substance P

Arg–Pro–Lys–Pro–Gln–Gln–Phe–Phe–Gly–Leu–Met–NH_2

Vasoactive intestinal peptide



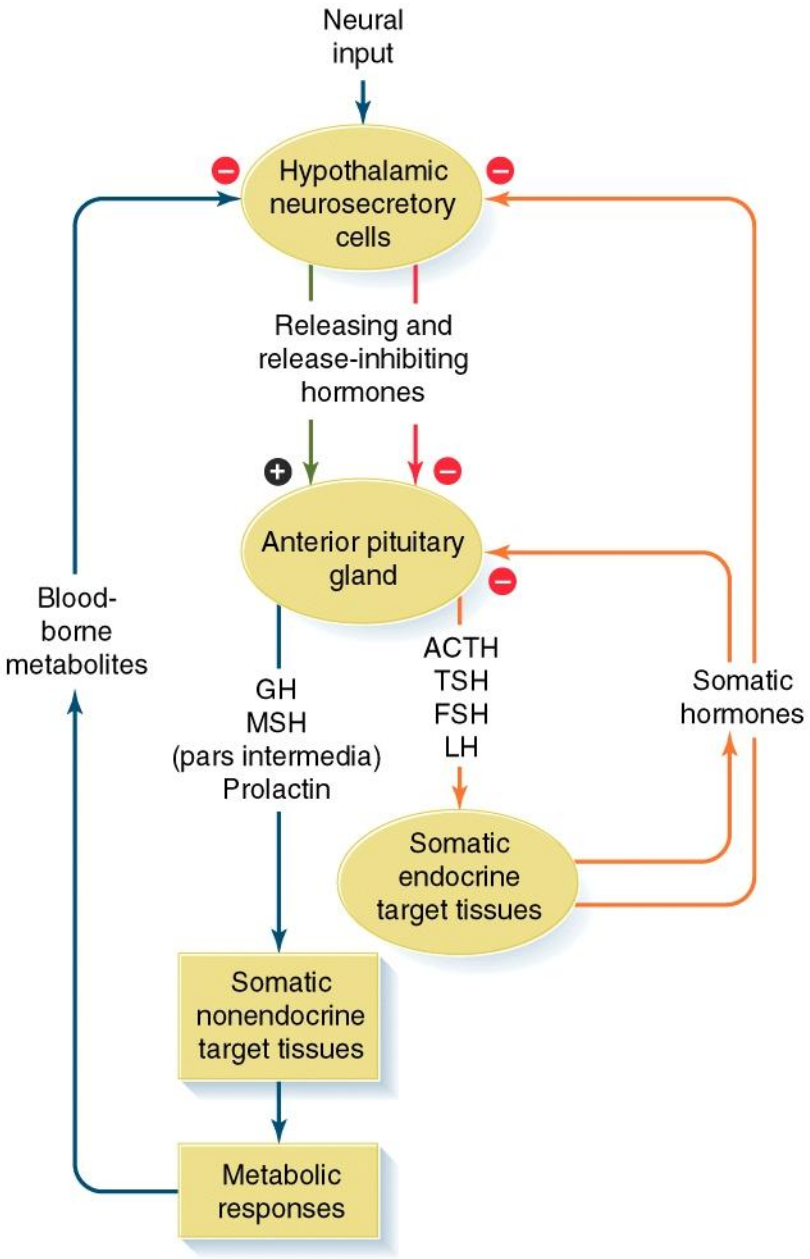
Cholecystokinin (brain)

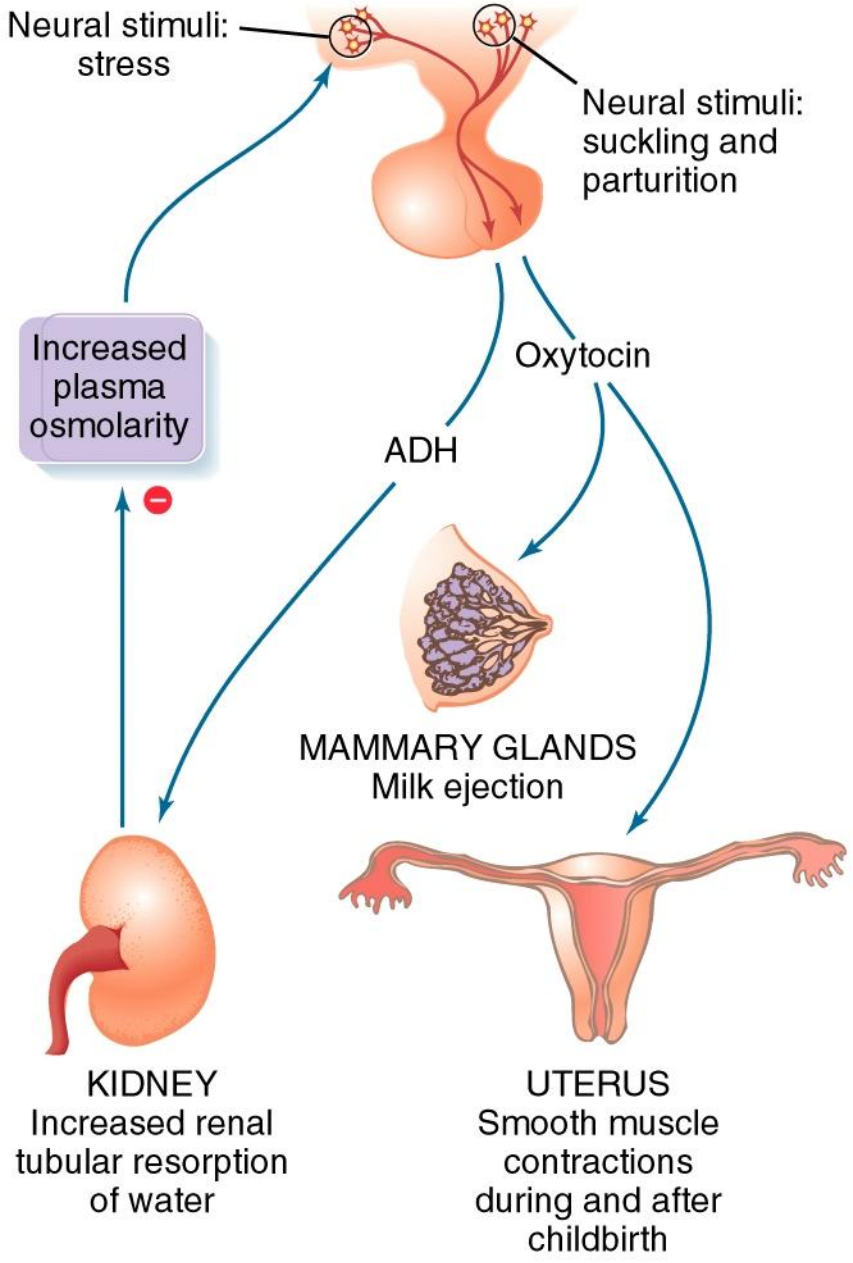
Asp–Tyr–Met–Gly–Trp–Met–Asp–Phe–NH_2

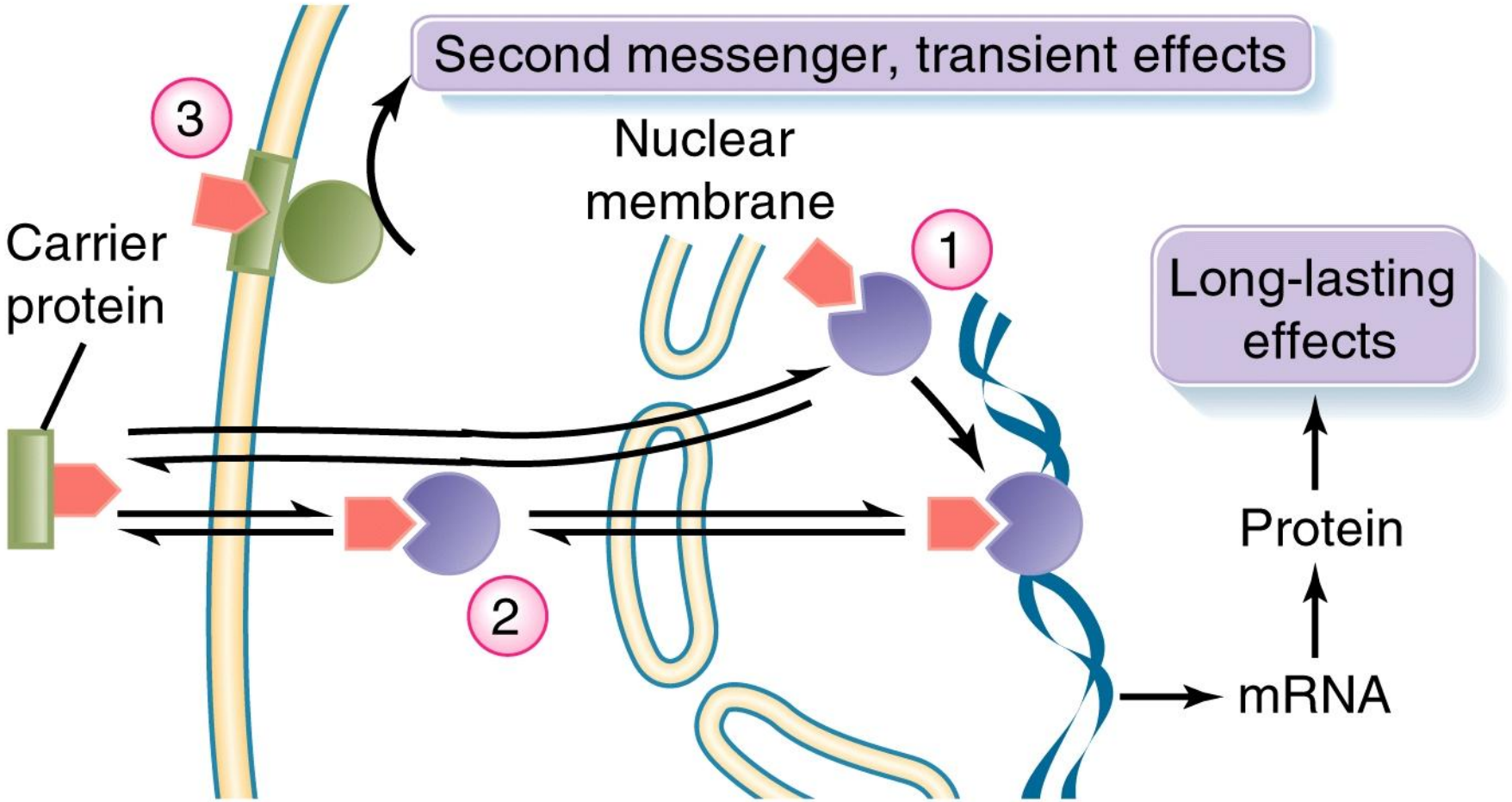
Table 9-3 Tropic hormones of the anterior pituitary gland

Hormone	Structure	Target tissue	Primary action in mammals	Regulation*
Adrenocorticotropic hormone (ACTH)	Peptide	Adrenal cortex	Increases synthesis and secretion of steroid hormones by adrenal cortex	Cortical-releasing hormone (CRH) stimulates release; ACTH slows release of CRH
Follicle-stimulating hormone (FSH)	Glycoprotein	Ovarian follicles (female); seminiferous tubules (male)	In female, stimulates maturation of ovarian follicles; in male, increases sperm production	GnRH stimulates release; inhibin and steroid sex hormones inhibit release
Luteinizing hormone (LH)	Glycoprotein	Ovarian interstitial cells (female); testicular interstitial cells (male)	In female, induces final maturation of ovarian follicles, estrogen secretion, ovulation, corpus luteum formation, and progesterone secretion; in male, increases synthesis and secretion of androgens	GnRH stimulates release; inhibin and steroid sex hormones inhibit release
Thyroid-stimulating hormone (TSH)	Glycoprotein	Thyroid gland	Increases synthesis and secretion of thyroid hormones	TRH induces secretion; thyroid hormones and somatostatin slow release

*See Table 9-2 for key to abbreviations.


Neural input
Hypothalamic neurosecretory cells
Releasing and release-inhibiting hormones
Anterior pituitary gland
Blood-borne metabolites
GH
MSH
(pars intermedia)
Prolactin
ACTH
TSH
FSH
LH
Somatic hormones
Somatic endocrine target tissues
Somatic nonendocrine target tissues
Metabolic responses


Neural stimuli:
stress
Neural stimuli:
suckling and
parturition
Increased
plasma
osmolarity
Oxytocin
ADH
MAMMARY GLANDS
Milk ejection
KIDNEY
Increased renal
tubular resorption
of water
UTERUS
Smooth muscle
contractions
during and after
childbirth


(a) Lipid-soluble hormone
Second messenger, transient effects
3
Nuclear membrane
Carrier protein
1
Long-lasting effects
Protein
2
mRNA

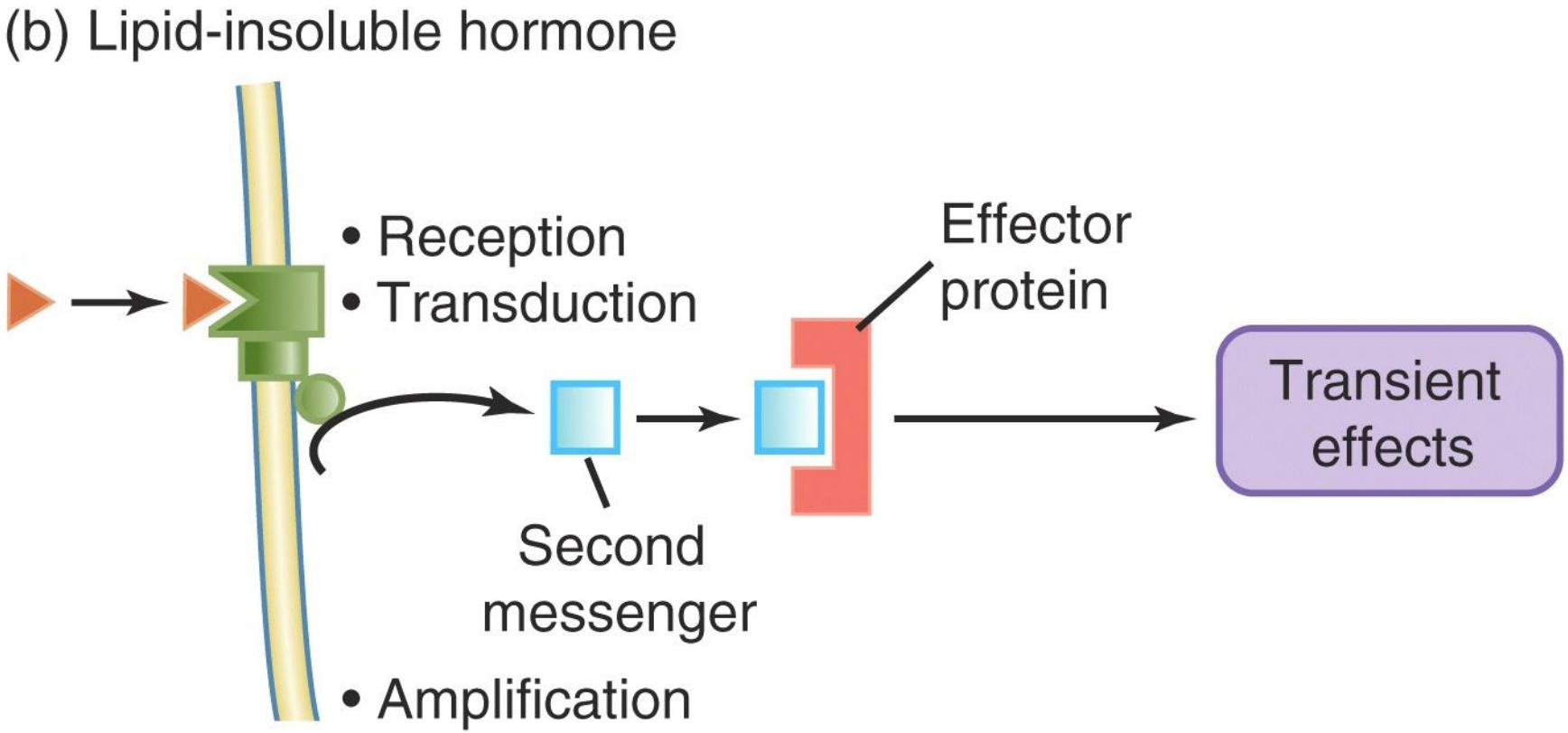

(b) Lipid-insoluble hormone
• Reception
• Transduction
Effector protein
Transient effects
Second messenger
• Amplification

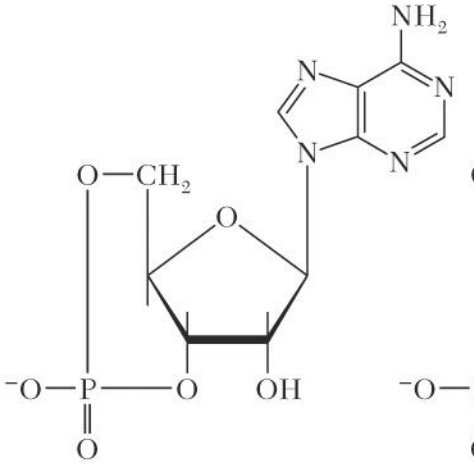
Table 9-5 Comparison of lipid-soluble and lipid-insoluble hormones

	Lipid-soluble		Lipid-insoluble	
Property	Steroids	Thyroid hormones	Peptides and proteins	Catecholamines
Feedback regulation of synthesis	Yes	Yes	Yes	Yes
Binding to carrier proteins	Yes	Yes	Rarely	No
Lifetime in blood plasma	Hours	Days	Minutes	Seconds
Time course of action	Hours to days	Days	Minutes to hours	Seconds or less
Receptor location	Cytosolic or nuclear	Nuclear	Plasma membrane	Plasma membrane
Mechanism of action	Receptor-hormone complex stimulates or inhibits gene expression		Hormone binding triggers second-messenger or activates intrinsic catalytic activity	Hormone binding causes change in membrane potential or triggers second-messenger pathway

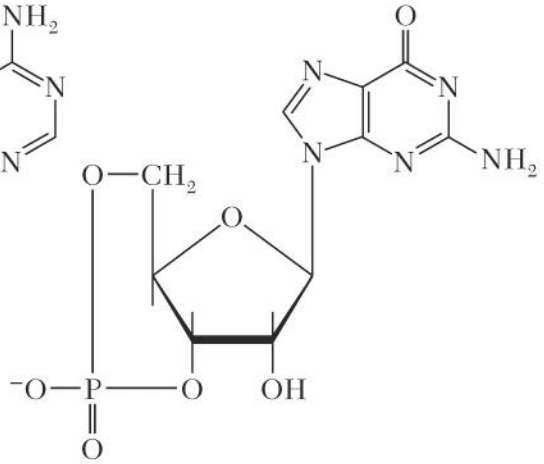
Source: Adapted from Smith et al., 1983, p. 358. Used with permission of McGraw-Hill.

Receptors for steroids are also on the surface of cells

CYCLIC NUCLEOTIDES

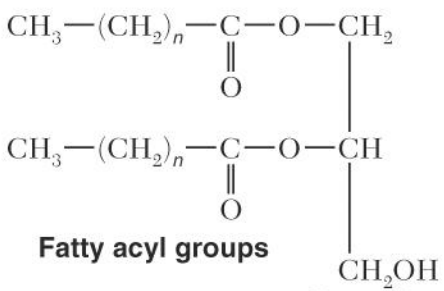


3′,5′-Cyclic AMP
(cAMP)



3′,5′-Cyclic GMP
(cGMP)

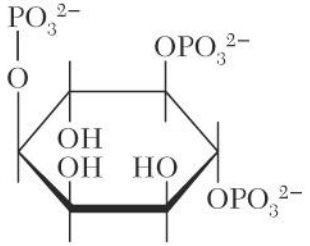
INOSITOL PHOSPHOLIPIDS



Fatty acyl groups

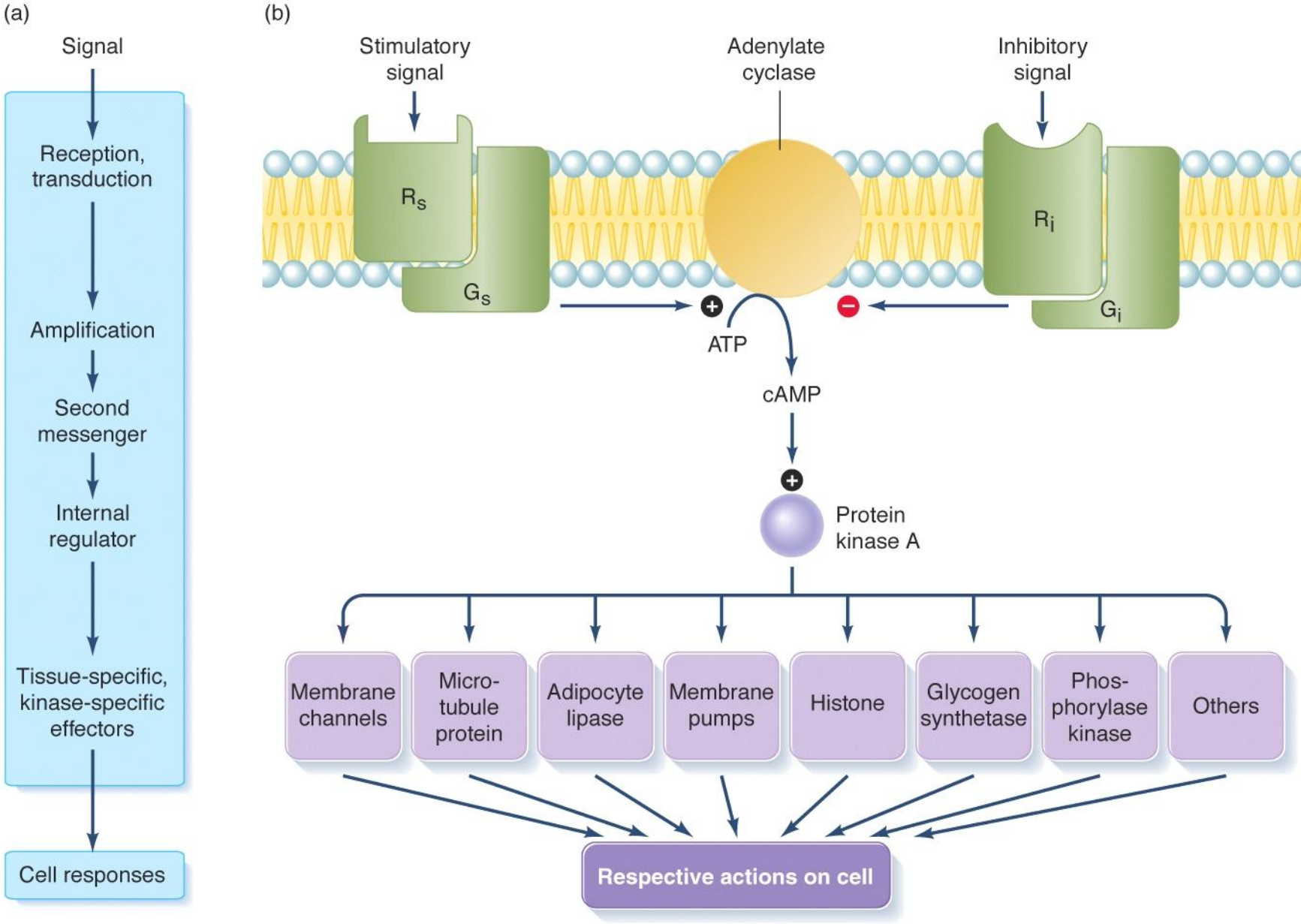
Glycerol

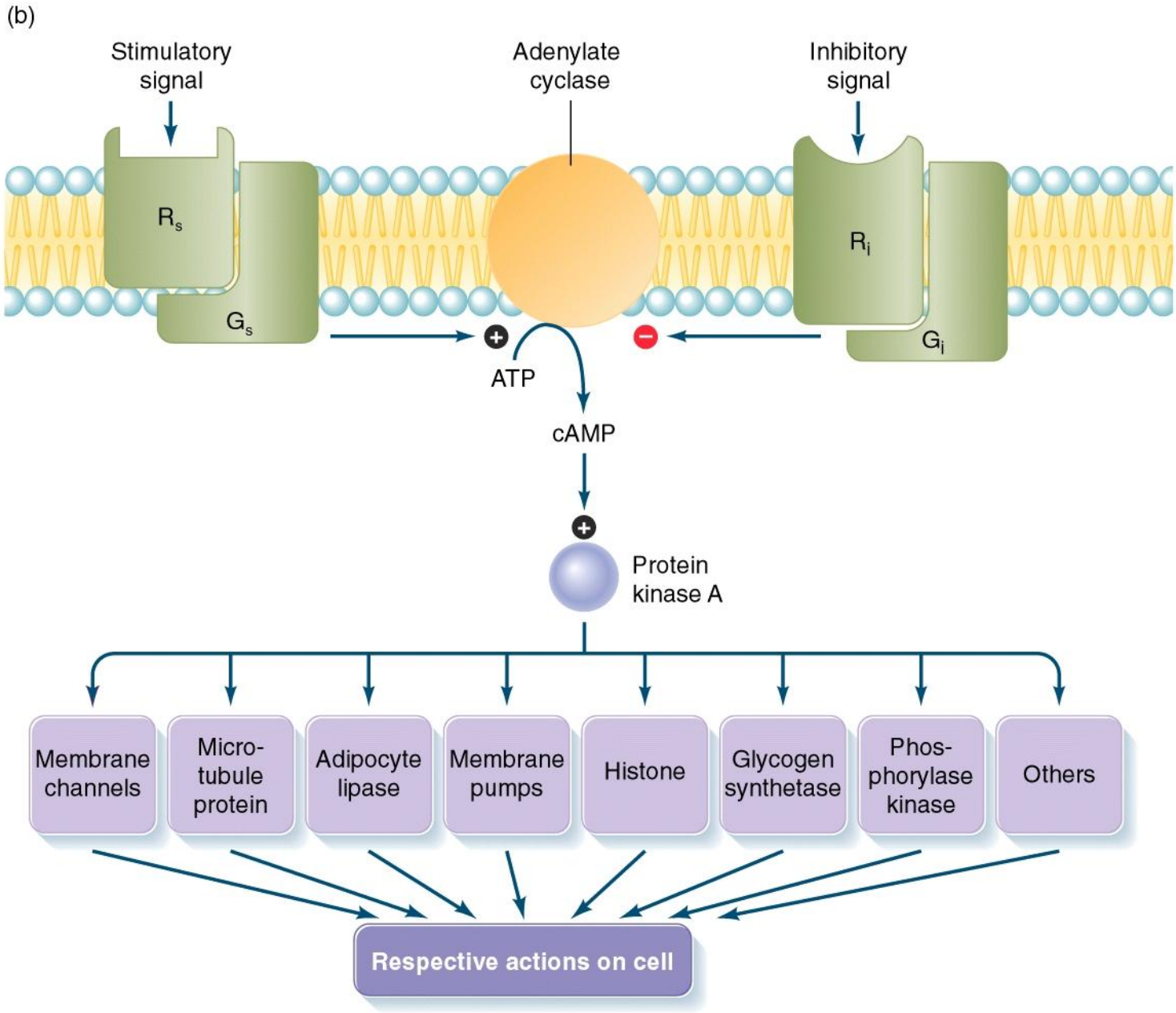
1,2-Diacylglycerol
(DAG)

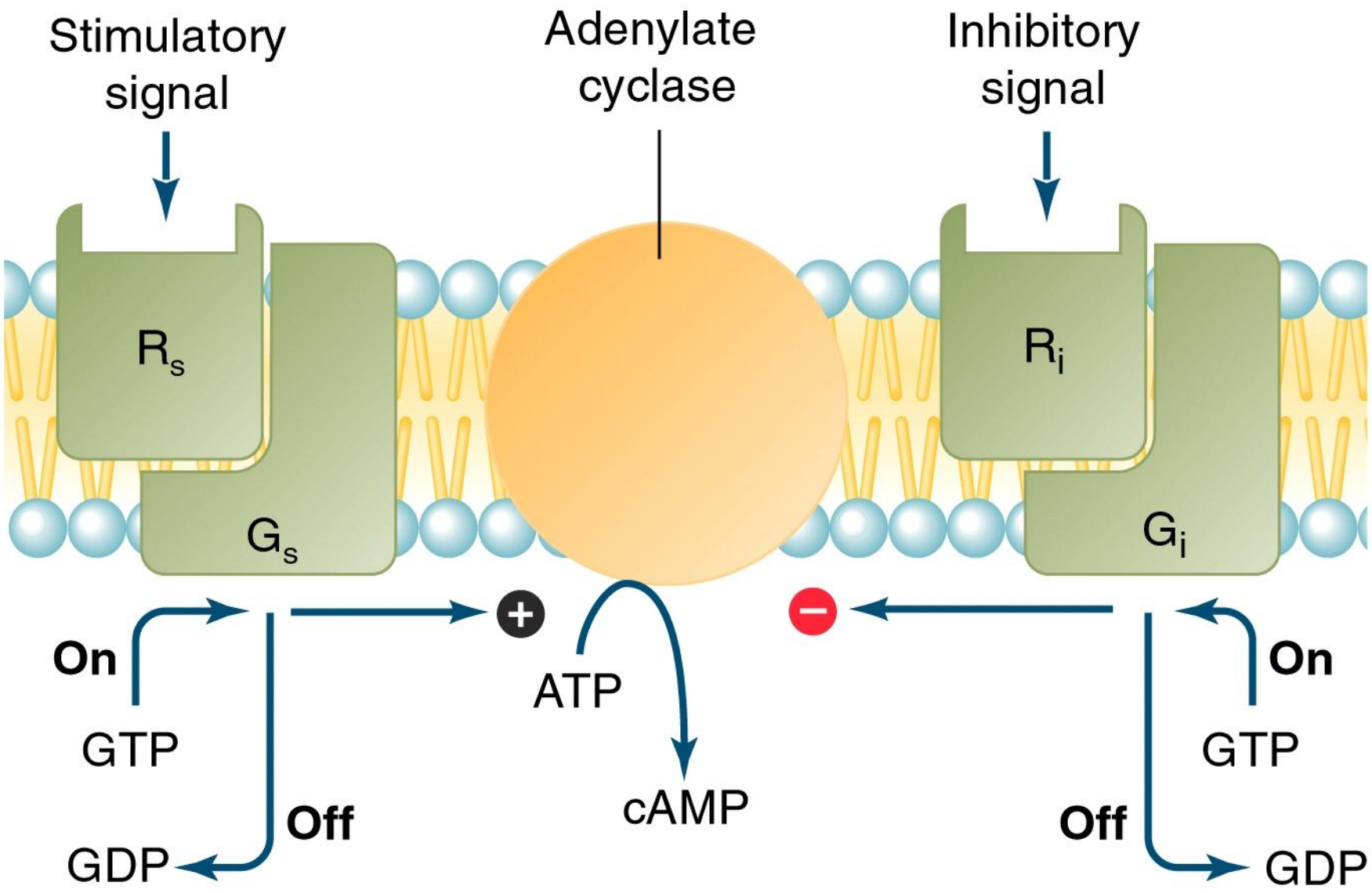


Inositol
1,4,5-trisphosphate
(IP_3)

CALCIUM ION


(a)
Signal
Reception, transduction
Amplification
Second messenger
Internal regulator
Tissue-specific, kinase-specific effectors
Cell responses
(b)
Stimulatory signal
Adenylate cyclase
Inhibitory signal
R_s
G_s
R_i
G_i
ATP
cAMP
Protein kinase A
Membrane channels
Micro-tubule protein
Adipocyte lipase
Membrane pumps
Histone
Glycogen synthetase
Phos-phorylase kinase
Others
Respective actions on cell


(b)
Stimulatory signal
Adenylate cyclase
Inhibitory signal
R_s
G_s
R_i
G_i
ATP
cAMP
Protein kinase A
Membrane channels
Micro-tubule protein
Adipocyte lipase
Membrane pumps
Histone
Glycogen synthetase
Phos-phorylase kinase
Others
Respective actions on cell


Stimulatory signal
Adenylate cyclase
Inhibitory signal
R_s
G_s
R_i
G_i
On
GTP
Off
GDP
ATP
cAMP
On
GTP
Off
GDP

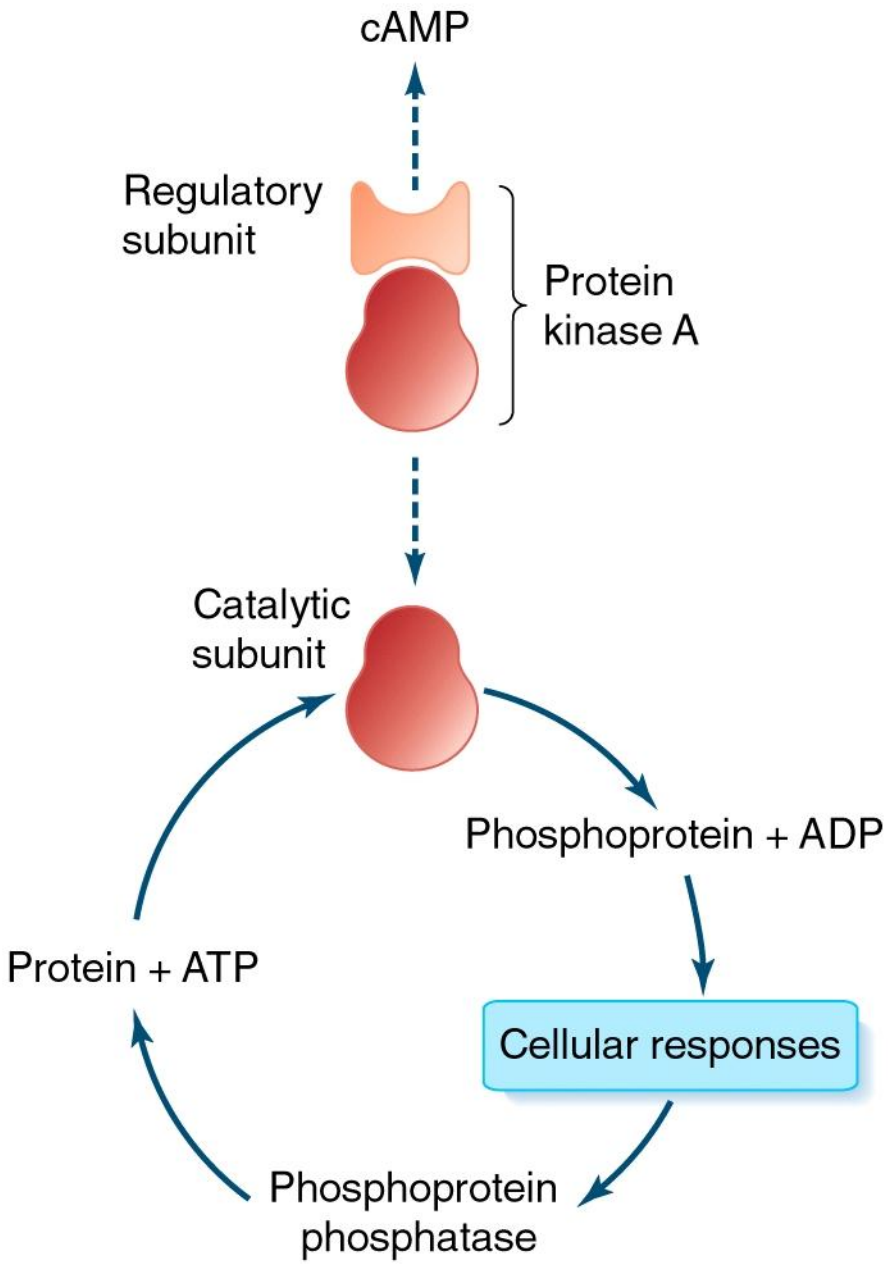
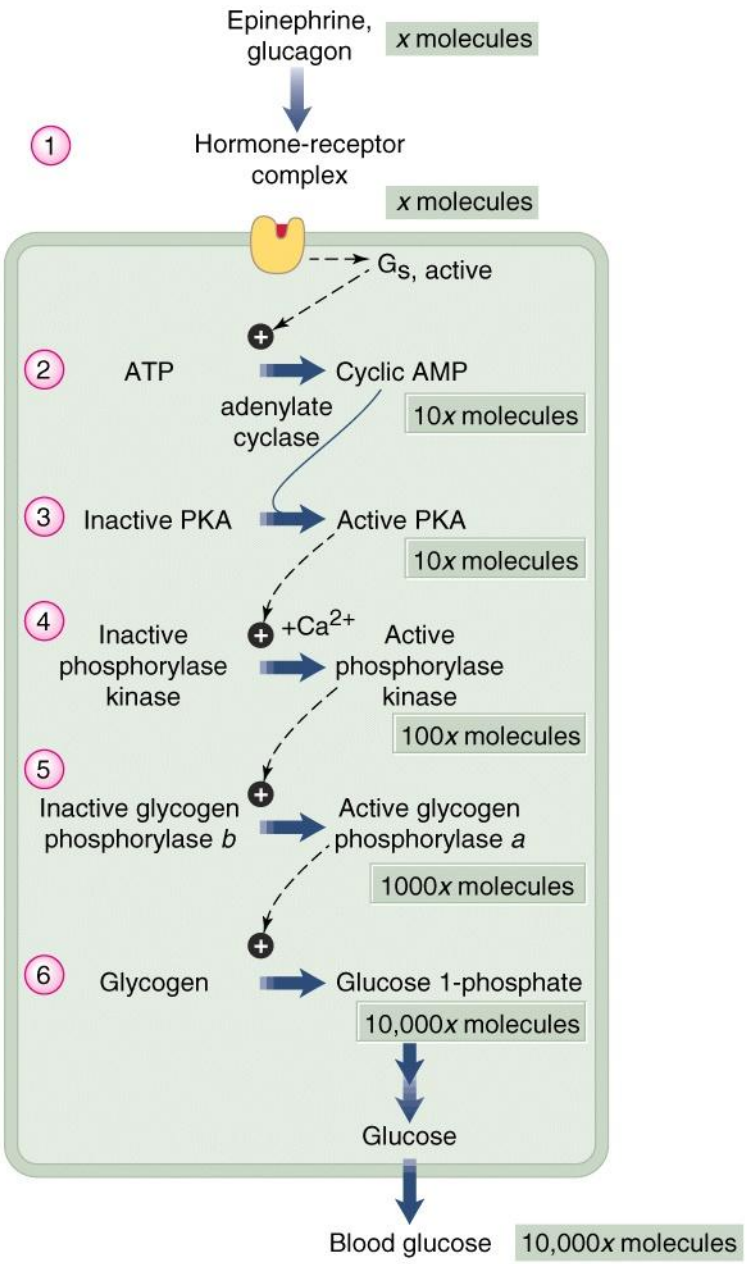
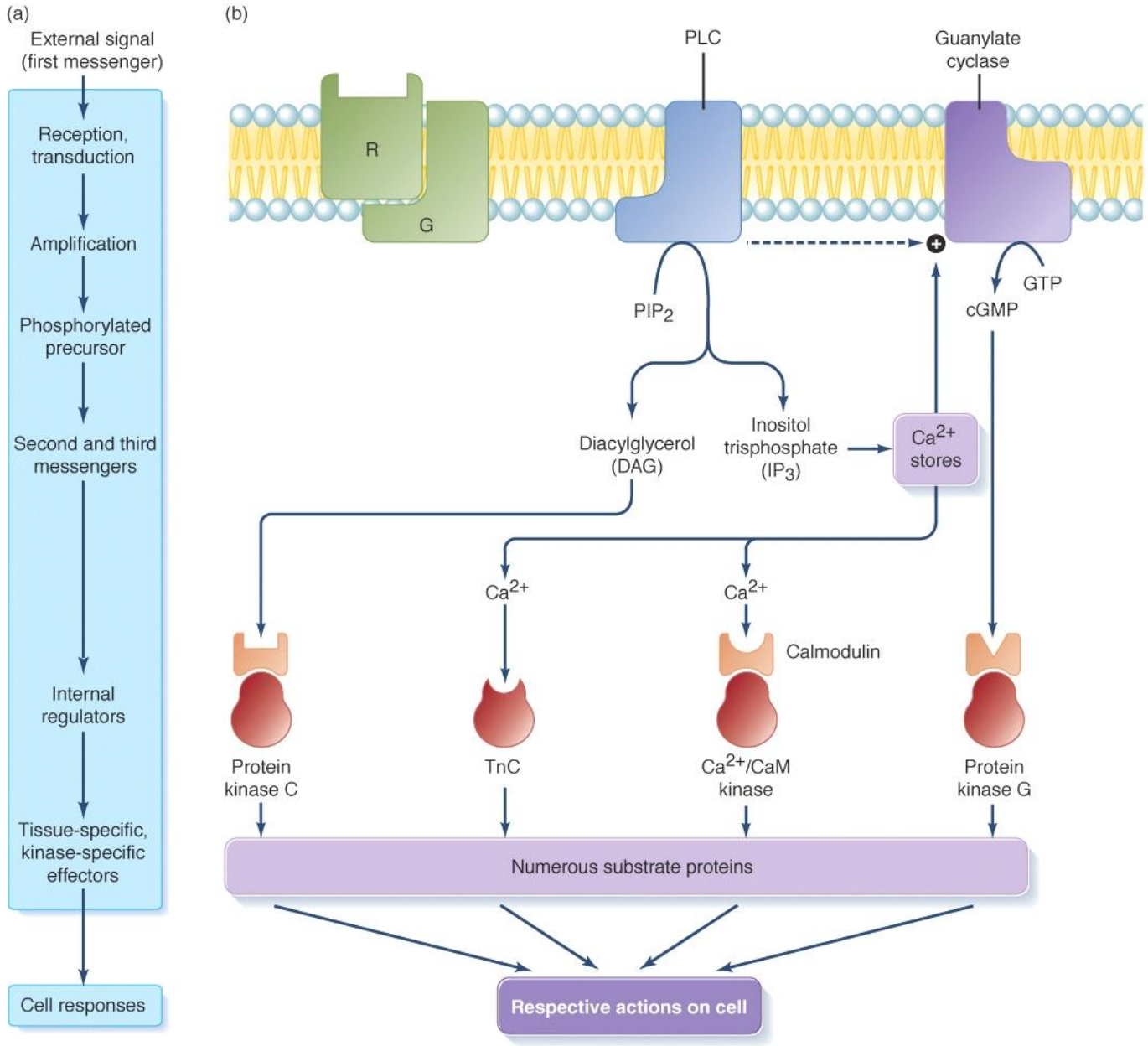

cAMP
Regulatory subunit
Protein kinase A
Catalytic subunit
Phosphoprotein + ADP
Cellular responses
Phosphoprotein phosphatase
Protein + ATP

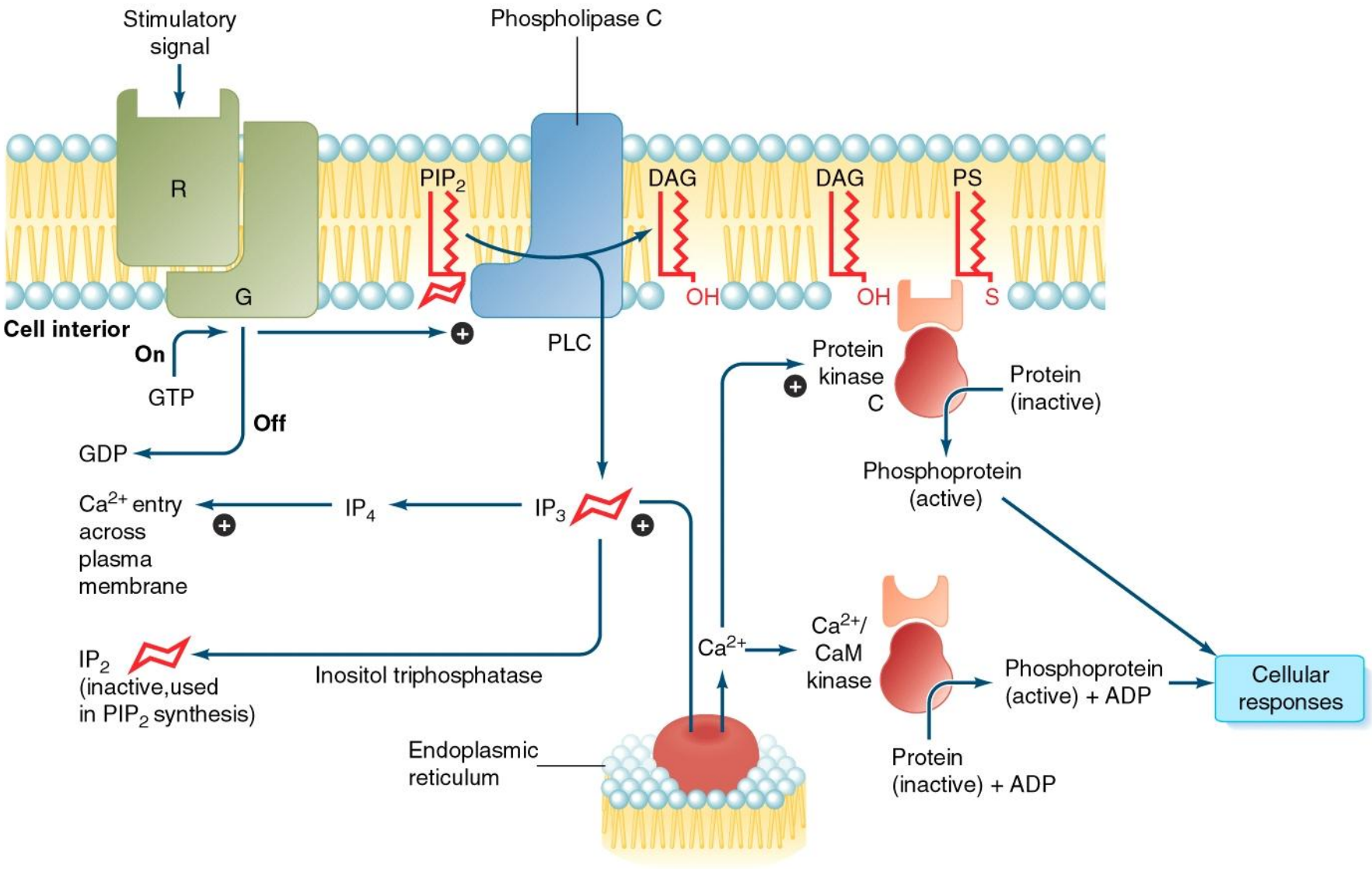
Table 9-6 **Some hormone-induced responses mediated by the cAMP pathway**

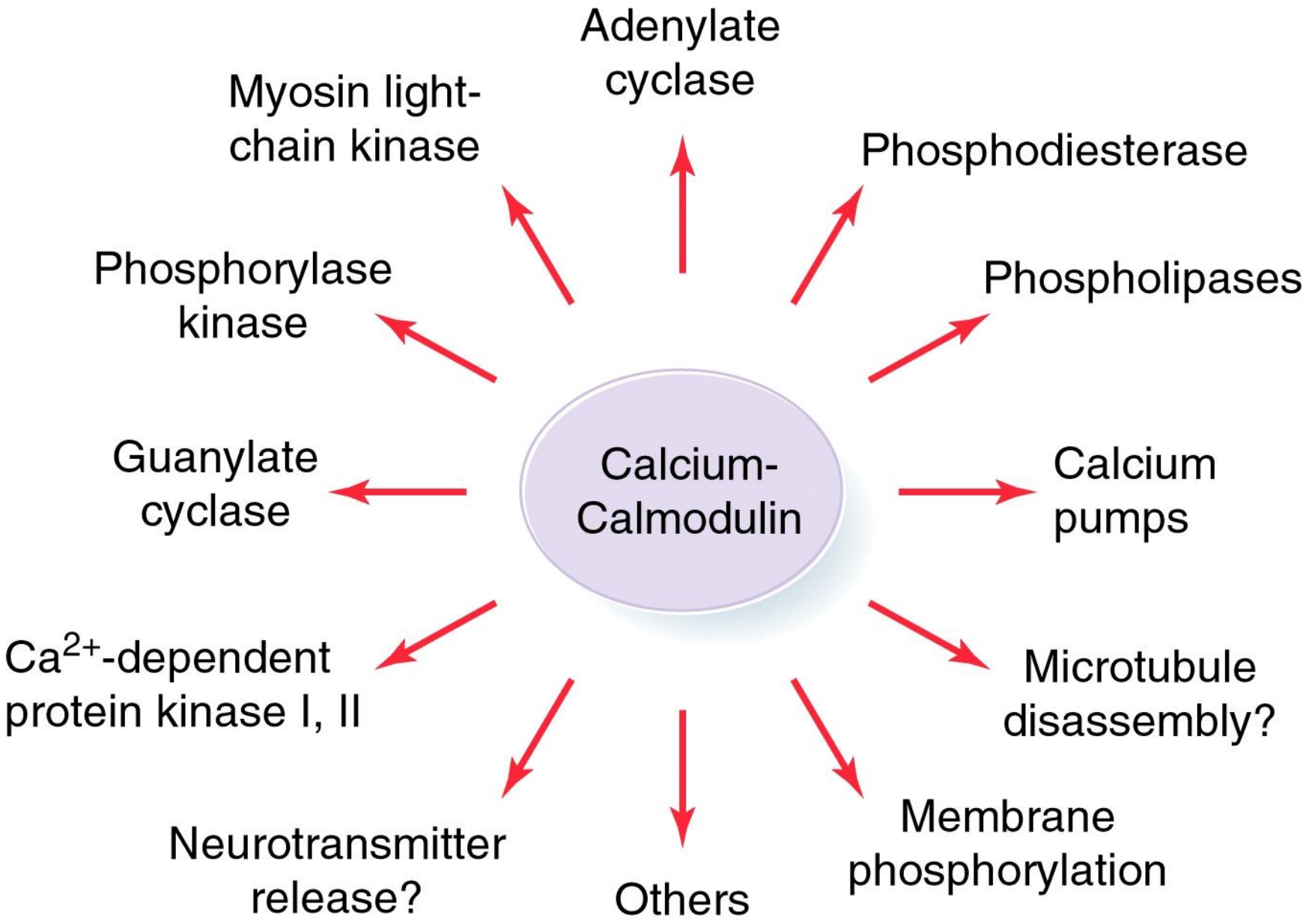
Signal	Tissue	Cellular response
Stimulatory		
Epinephrine (β-adrenoreceptors)	Skeletal muscle	Breakdown of glycogen
	Fat cells	Increased breakdown of lipids
	Heart	Increased heart rate and force of contraction
	Intestine	Fluid secretion
	Smooth muscle	Relaxation
Thyroid-stimulating hormone (TSH)	Thyroid gland	Thyroxine secretion
ADH (vasopressin)	Kidney	Reabsorption of water
Glucagon	Liver	Breakdown of glycogen
Serotonin	Salivary gland (blowfly)	Fluid secretion
Prostaglandin I_2	Blood platelets	Inhibition of aggregation and secretion
Inhibitory		
Epinephrine (α_2-adrenoreceptors)	Blood platelets	Stimulation of aggregation and secretion
	Fat cells	Decreased lipid breakdown
Adenosine	Fat cells	Decreased lipid breakdown

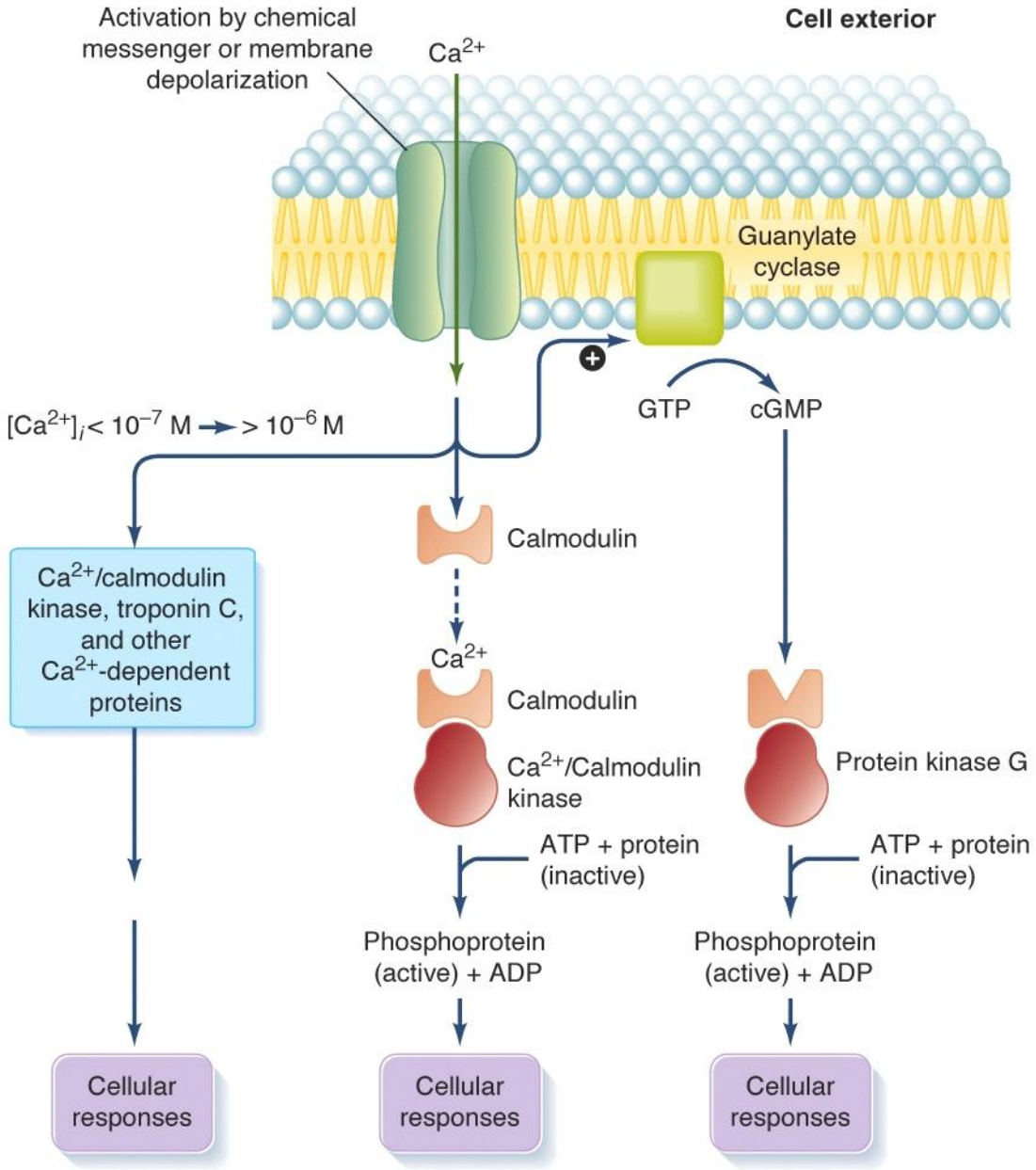
Source: Berridge, 1985.

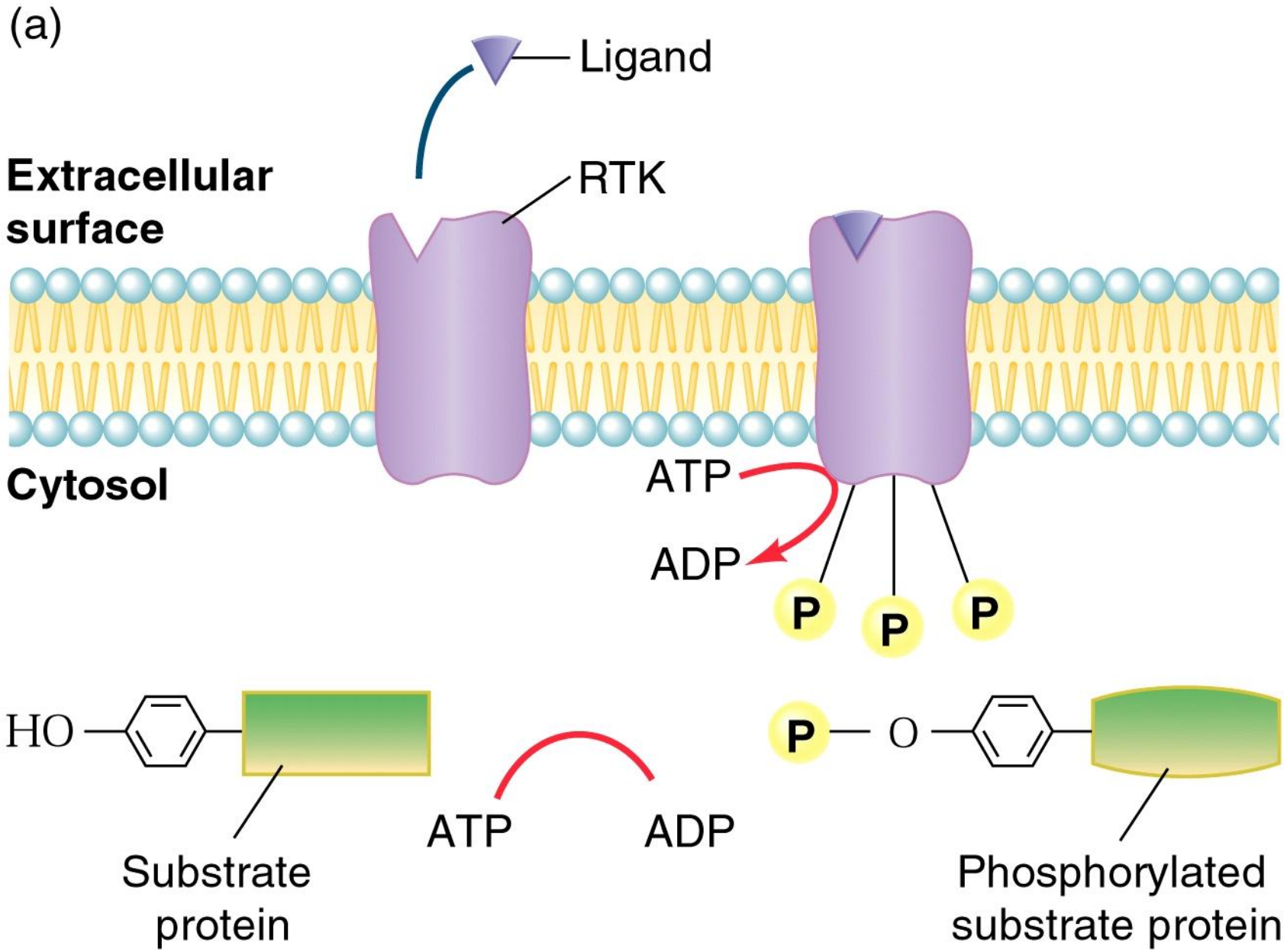

Epinephrine, glucagon
x molecules
1
Hormone-receptor complex
x molecules
Gs, active
2
ATP
Cyclic AMP
adenylate cyclase
10x molecules
3
Inactive PKA
Active PKA
10x molecules
4
+Ca2+
Inactive phosphorylase kinase
Active phosphorylase kinase
100x molecules
5
Inactive glycogen phosphorylase b
Active glycogen phosphorylase a
1000x molecules
6
Glycogen
Glucose 1-phosphate
10,000x molecules
Glucose
Blood glucose
10,000x molecules

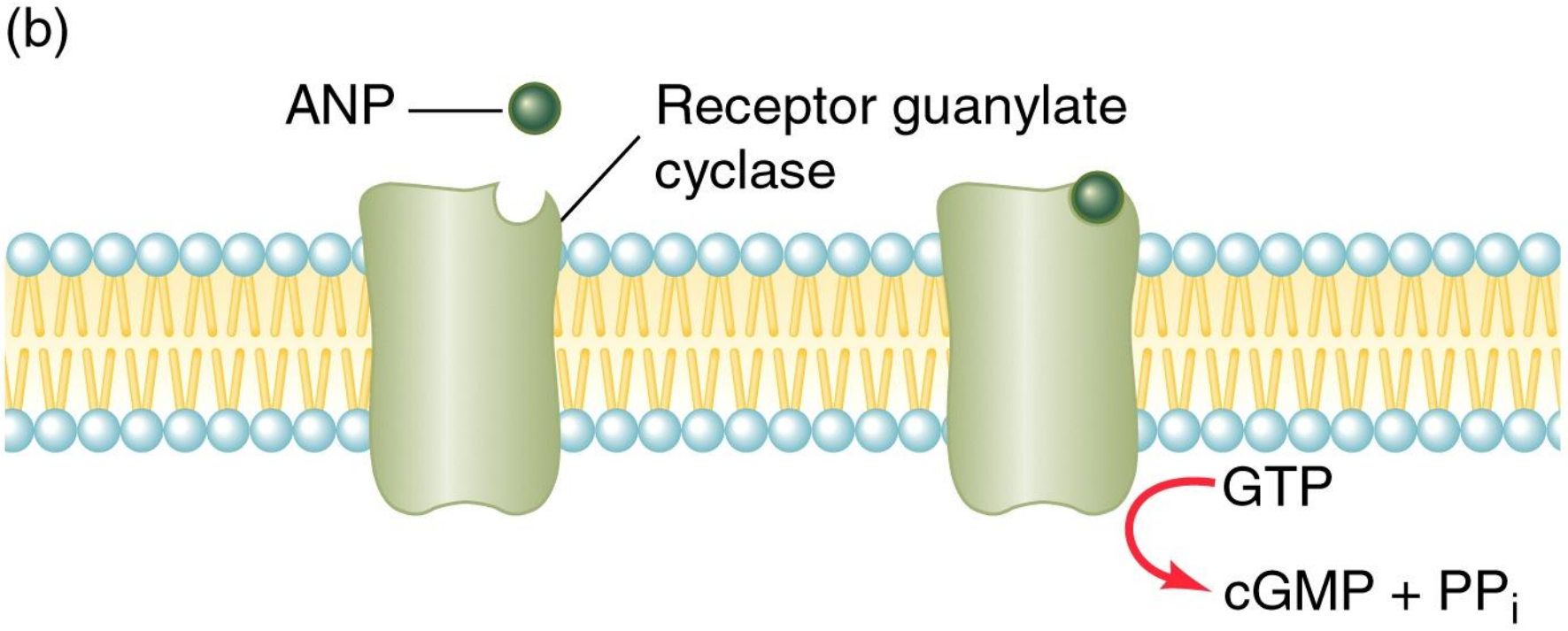

(a)
External signal
(first messenger)
Reception,
transduction
Amplification
Phosphorylated
precursor
Second and third
messengers
Internal
regulators
Tissue-specific,
kinase-specific
effectors
Cell responses
(b)
PLC
Guanylate
cyclase
R
G
PIP2
GTP
cGMP
Diacylglycerol
(DAG)
Inositol
trisphosphate
(IP3)
Ca2+
stores
Ca2+
Ca2+
Calmodulin
Protein
kinase C
TnC
Ca2+/CaM
kinase
Protein
kinase G
Numerous substrate proteins
Respective actions on cell

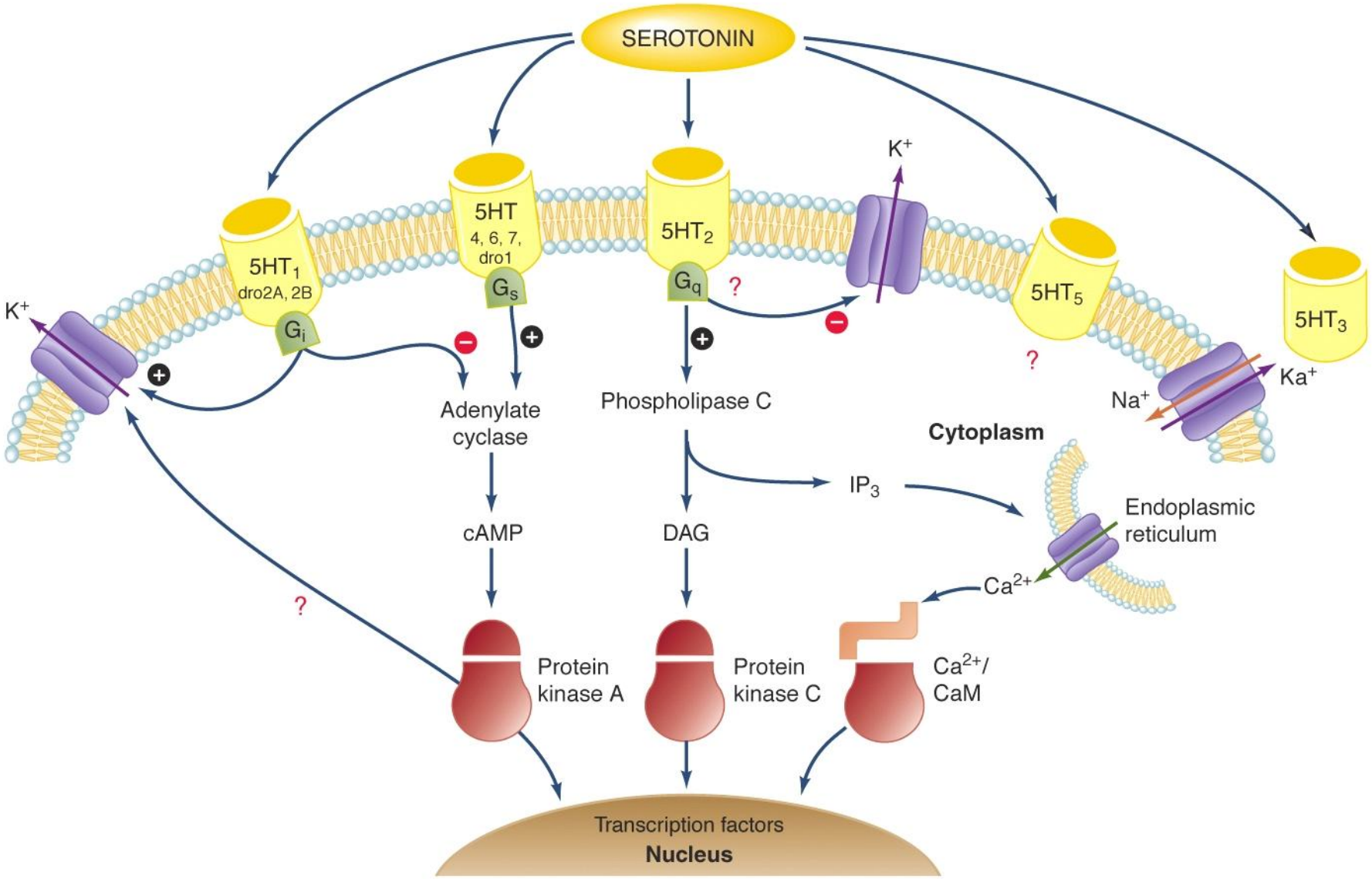

Stimulatory signal
Phospholipase C
R
G
PIP2
DAG
DAG
PS
OH
OH
S
Cell interior
On
GTP
Off
GDP
PLC
Protein kinase C
Protein (inactive)
Phosphoprotein (active)
Ca2+ entry across plasma membrane
IP4
IP3
IP2 (inactive,used in PIP2 synthesis)
Inositol triphosphatase
Ca2+
Ca2+/ CaM kinase
Phosphoprotein (active) + ADP
Protein (inactive) + ADP
Cellular responses
Endoplasmic reticulum


Adenylate cyclase
Myosin light-chain kinase
Phosphodiesterase
Phosphorylase kinase
Phospholipases
Guanylate cyclase
Calcium-Calmodulin
Calcium pumps
Ca^{2+}-dependent protein kinase I, II
Microtubule disassembly?
Neurotransmitter release?
Others
Membrane phosphorylation


Activation by chemical messenger or membrane depolarization
Cell exterior
Ca^{2+}
Guanylate cyclase
GTP
cGMP
$[Ca^{2+}]_i < 10^{-7}$ M → > 10^{-6} M
Calmodulin
Ca^{2+}/calmodulin kinase, troponin C, and other Ca^{2+}-dependent proteins
Ca^{2+}
Calmodulin
Ca^{2+}/Calmodulin kinase
Protein kinase G
ATP + protein (inactive)
ATP + protein (inactive)
Phosphoprotein (active) + ADP
Phosphoprotein (active) + ADP
Cellular responses
Cellular responses
Cellular responses


(a)
Ligand
Extracellular surface
RTK
Cytosol
ATP
ADP
P
P
P
HO
Substrate protein
ATP
ADP
P
O
Phosphorylated substrate protein


(b)
ANP
Receptor guanylate cyclase
GTP
cGMP + PPi


SEROTONIN
5HT1
dro2A, 2B
Gi
5HT
4, 6, 7,
dro1
Gs
5HT2
Gq
?
K+
5HT5
5HT3
Ka+
Na+
?
K+
Adenylate
cyclase
Phospholipase C
Cytoplasm
IP3
Endoplasmic
reticulum
cAMP
DAG
Ca2+
?
Protein
kinase A
Protein
kinase C
Ca2+/
CaM
Transcription factors
Nucleus

Left Adrenal Gland

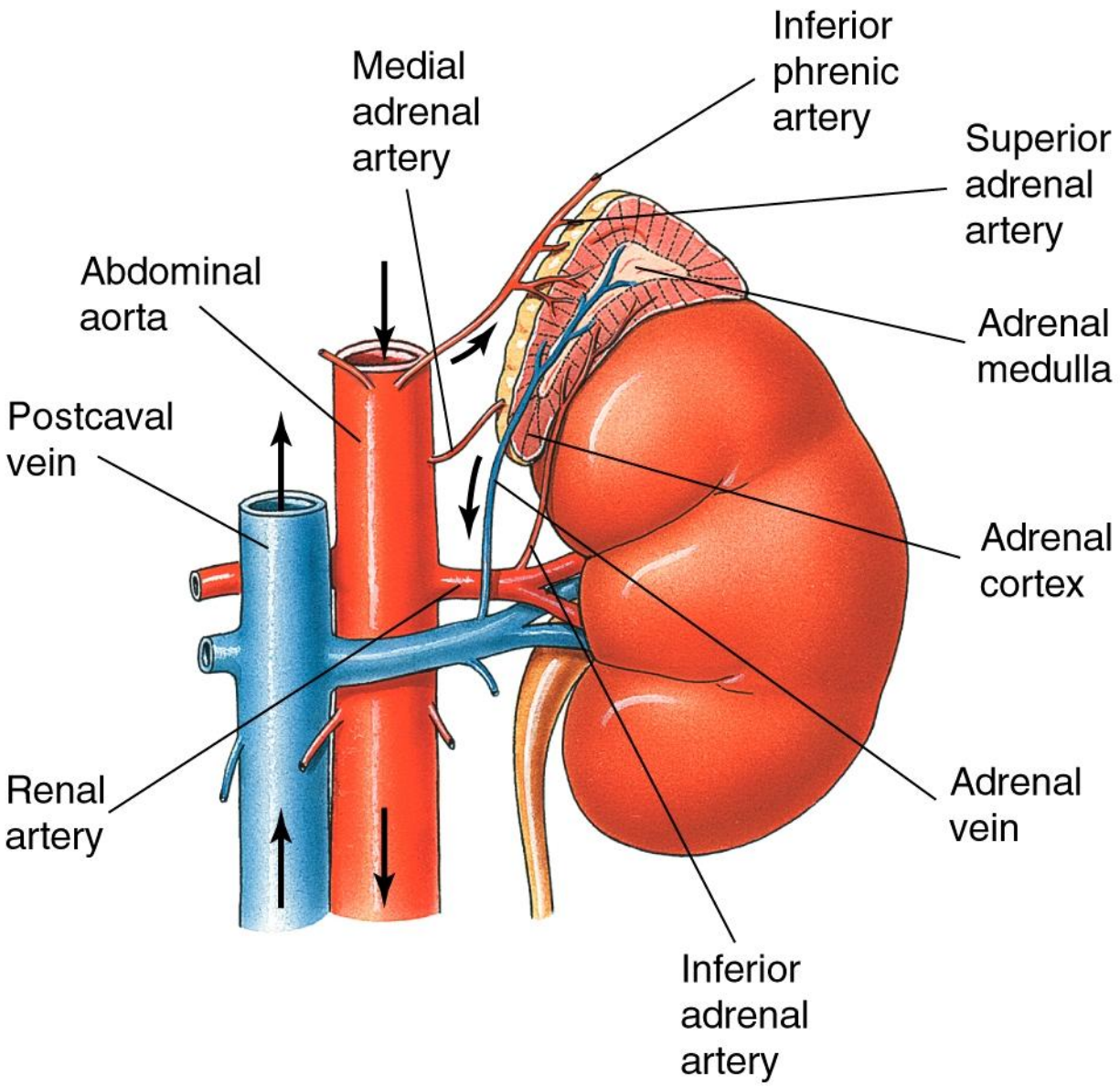
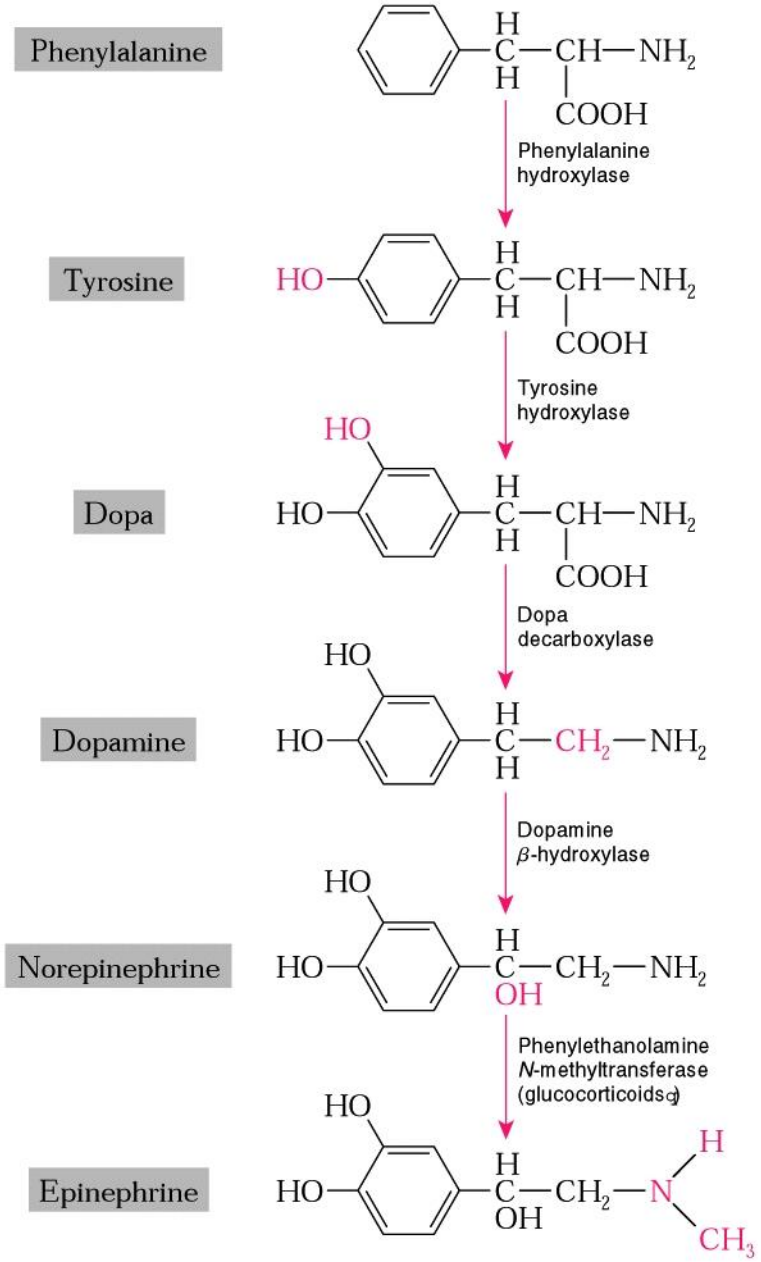


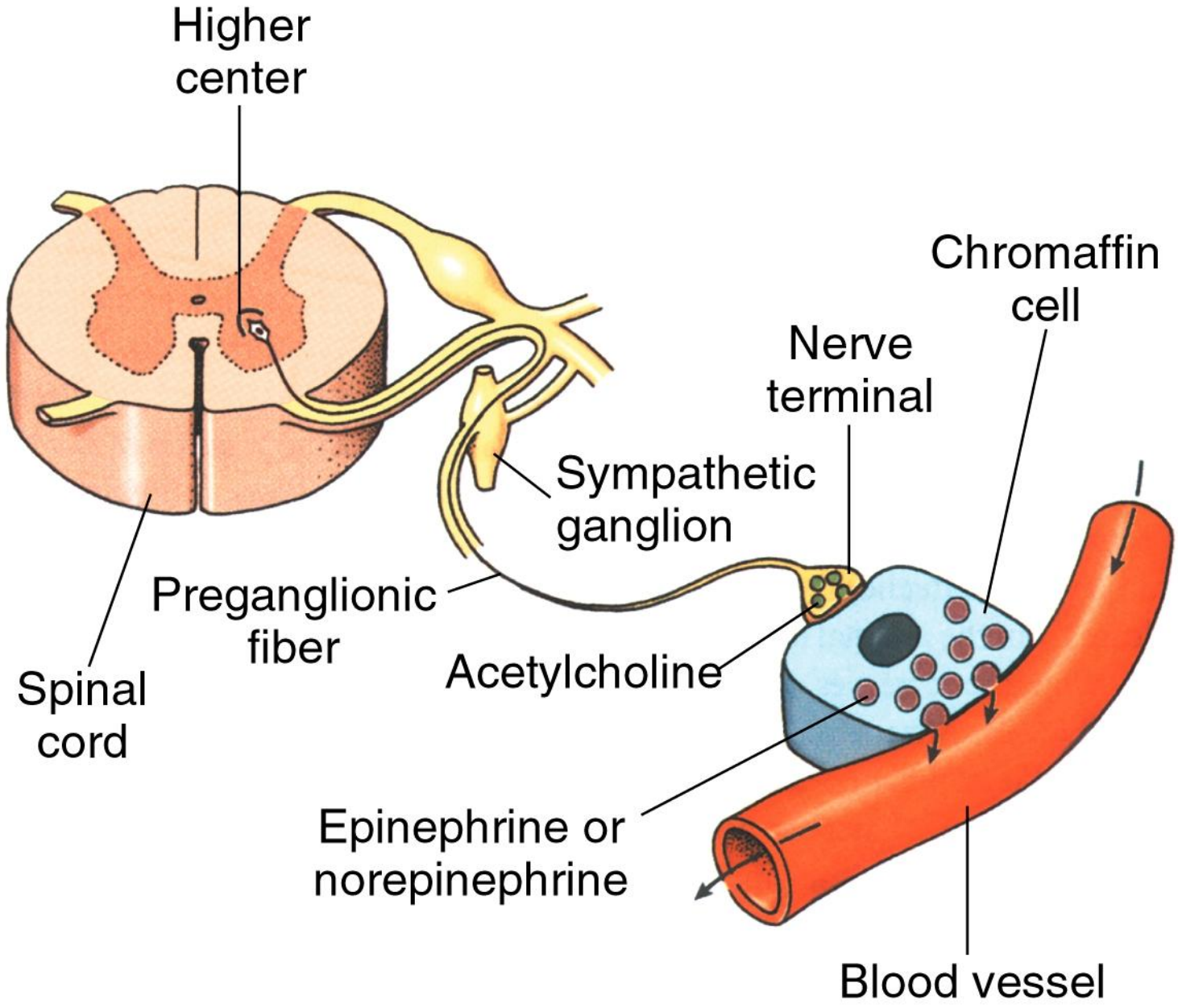
Table 9-7 Metabolic and developmental hormones

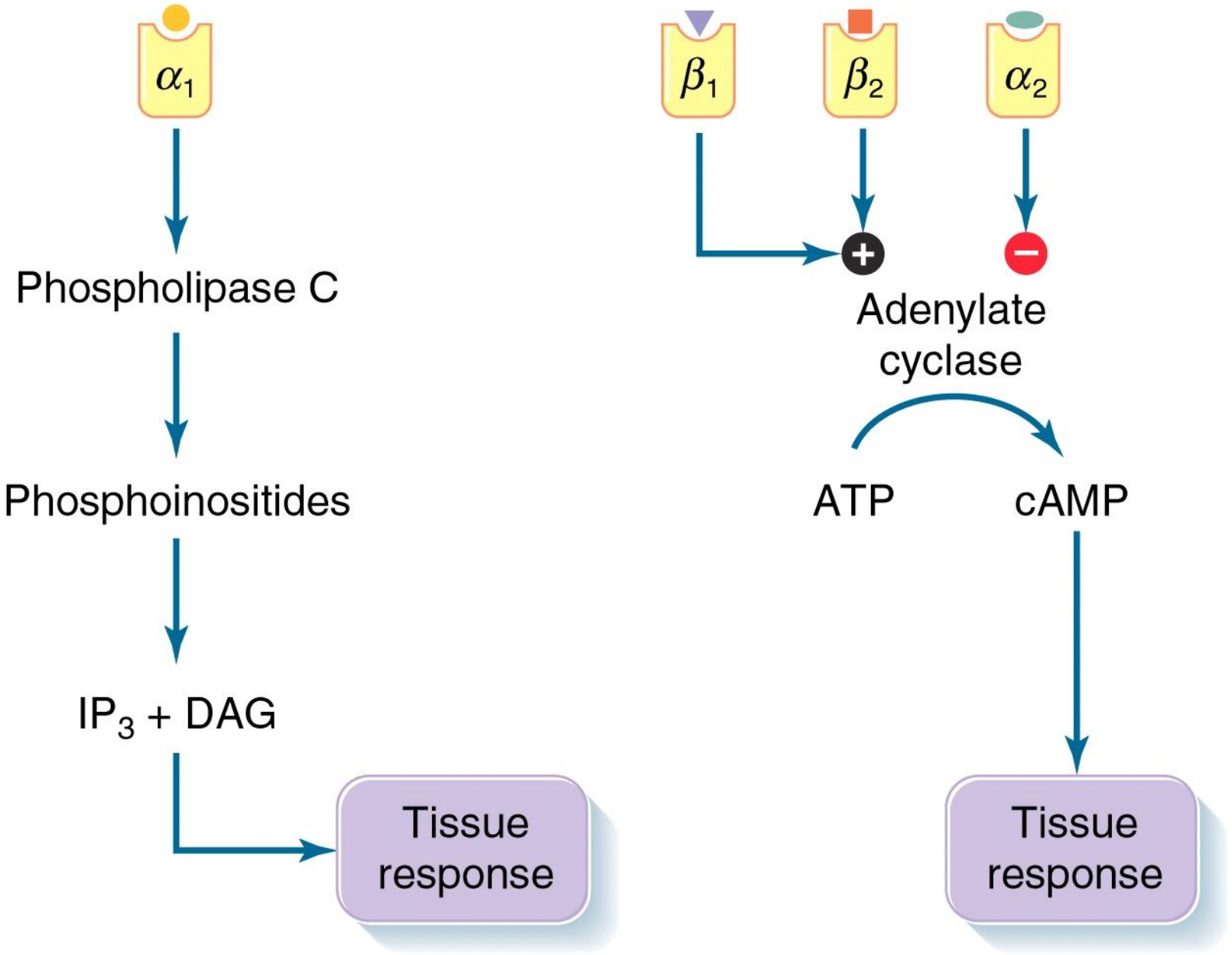
Hormone	Tissue of origin	Structure	Target tissue	Primary action	Regulation
Glucagon	Pancreas (alpha cells)	Peptide	Liver, adipose tissue	Stimulates glycogenolysis and release of glucose from liver; promotes lipolysis	Low serum glucose increases secretion; somatostatin inhibits release
Glucocorticoids (e.g., cortisol)	Adrenal cortex	Steroid	Liver, adipose tissue	Stimulate mobilization of amino acids from muscle and gluconeogenesis in liver to raise blood glucose; increase transfer of fatty acids from adipose tissue to liver; exhibit anti-inflammatory action	Physiological stress increases secretion; biological clock via CRH and ACTH controls diurnal changes in secretion
Growth hormone (GH)	Anterior pituitary	Peptide	All tissues	Stimulates RNA synthesis, protein synthesis, and tissue growth; increases transport of glucose and amino acids into cells; increase lipolysis and antibody formation	Reduced plasma glucose and increased plasma amino acid levels stimulate release via GRH; somatostatin inhibits release

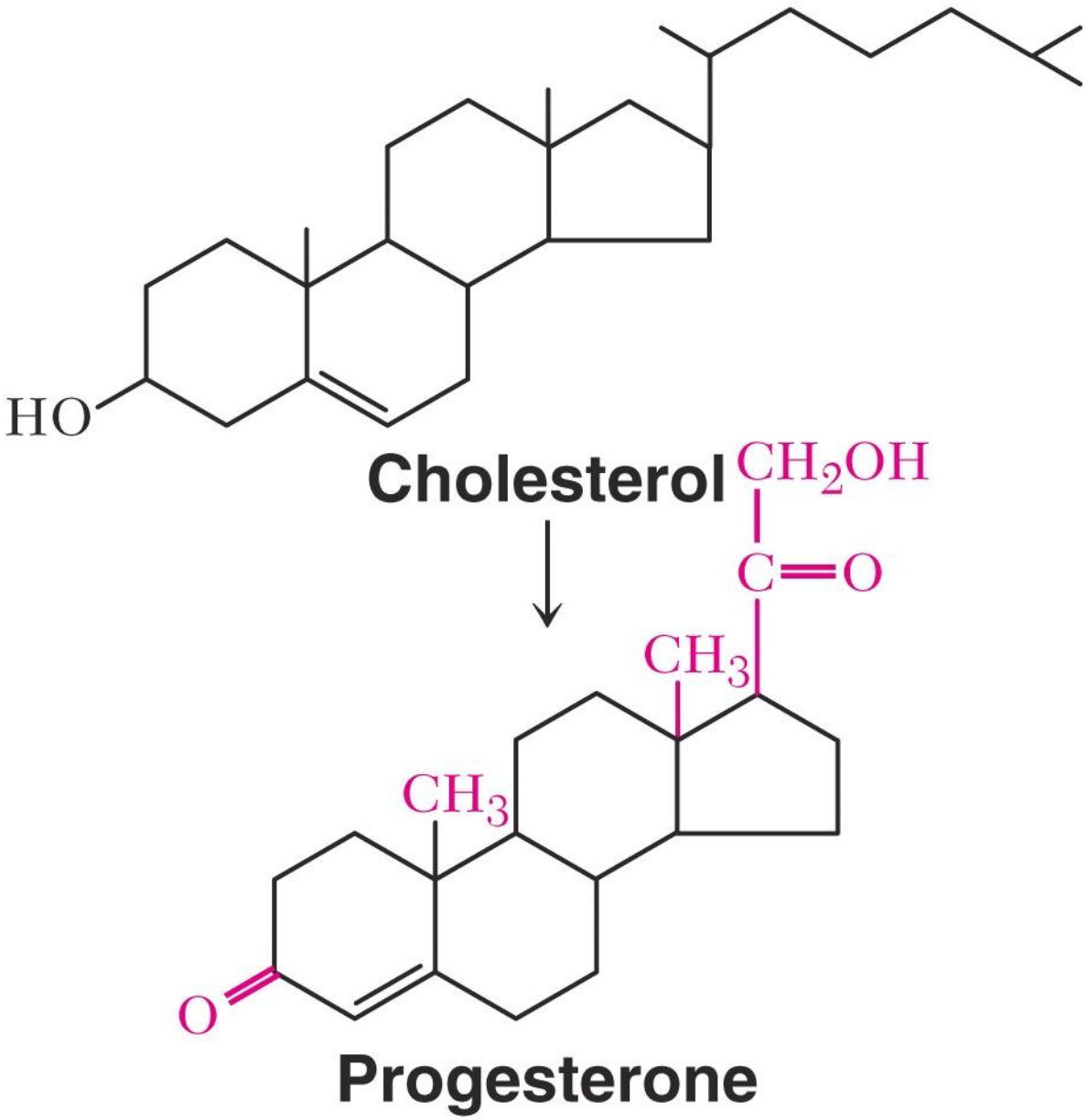
Table 9-7 Metabolic and developmental hormones

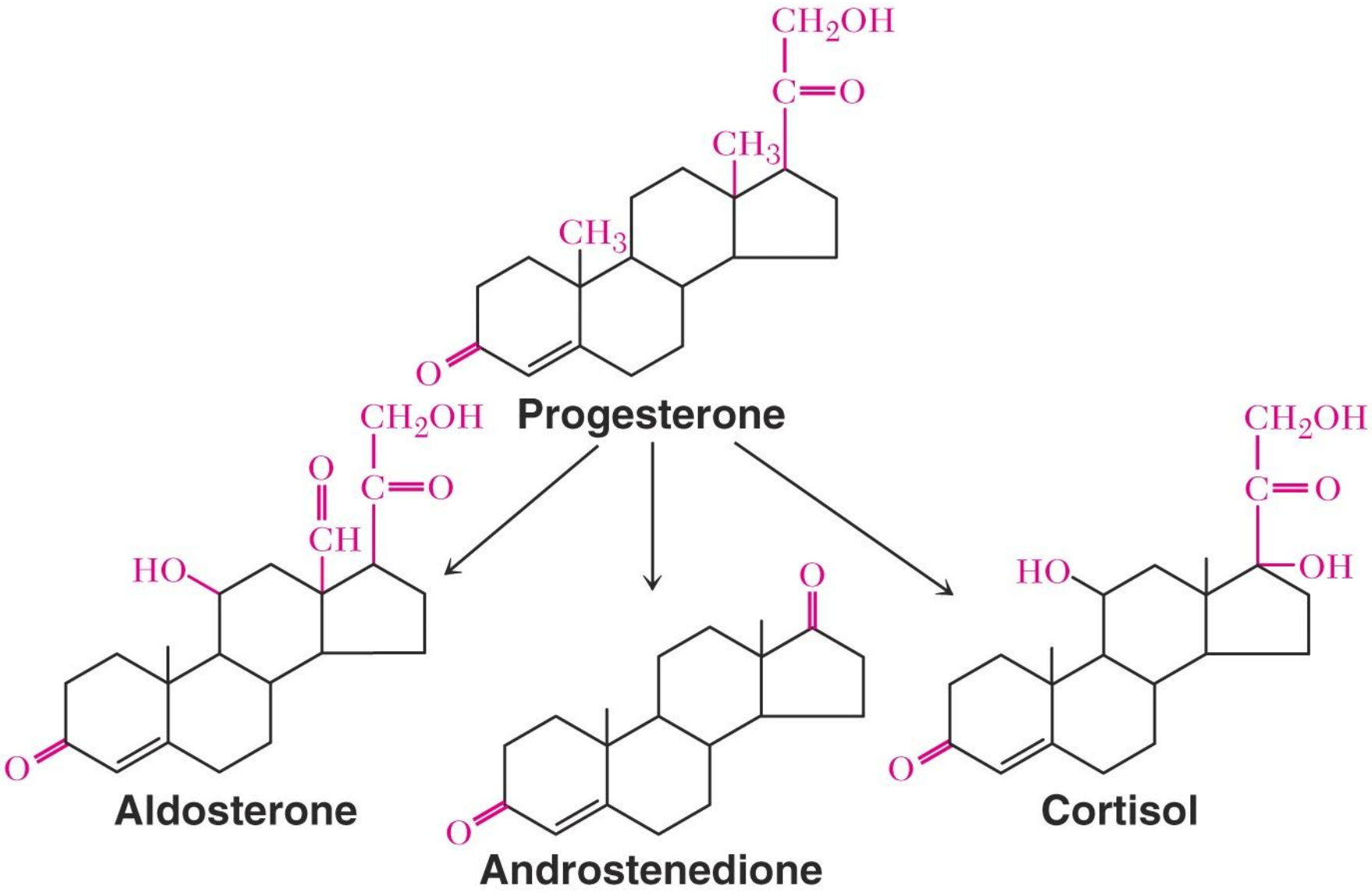
Hormone	Tissue of origin	Structure	Target tissue	Primary action	Regulation
Insulin	Pancreas (beta cells)	Peptide	All tissues except most neuronal tissue	Increases glucose and amino acid uptake by cells	High plasma glucose and amino acid levels and presence of glucagon increase secretion; somatostatin inhibits secretion
Norepinephrine and epinephrine	Adrenal medulla (chromaffin cells)	Catecholamine	Most tissues	Increase cardiac activity; induce vasoconstriction; increase glycolysis, hyperglycemia, and lipolysis	Sympathetic stimulation via splanchnic nerves increases secretion
Thyroxine	Thyroid	Tyrosine derivative	Most cells, but especially those of muscle, heart, liver, and kidney	Increases metabolic rate, thermogenesis, growth, and development; promotes amphibian metamorphosis	TSH induces release

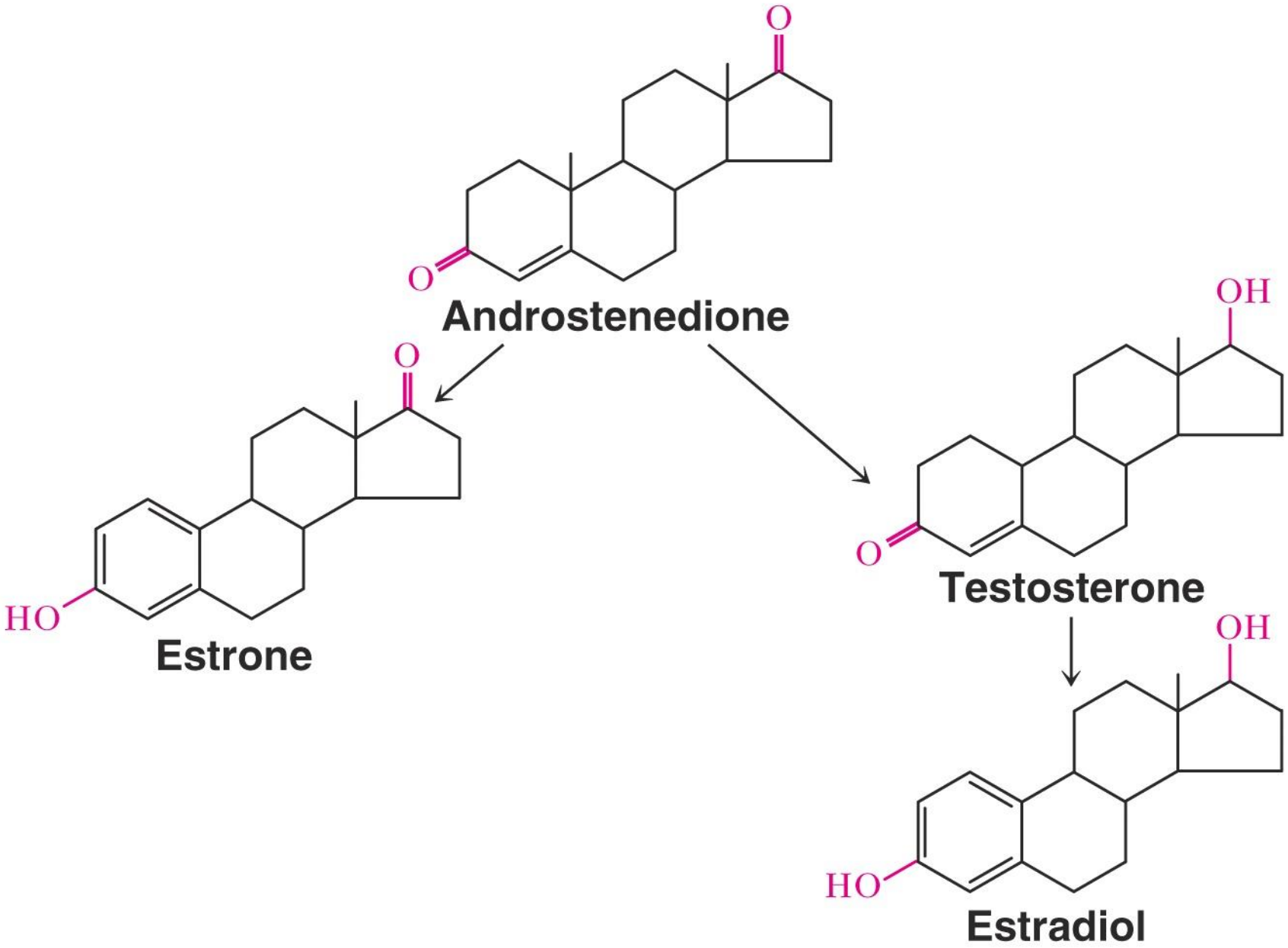

Phenylalanine
Phenylalanine hydroxylase
Tyrosine
Tyrosine hydroxylase
Dopa
Dopa decarboxylase
Dopamine
Dopamine β-hydroxylase
Norepinephrine
Phenylethanolamine N-methyltransferase (glucocorticoids)
Epinephrine

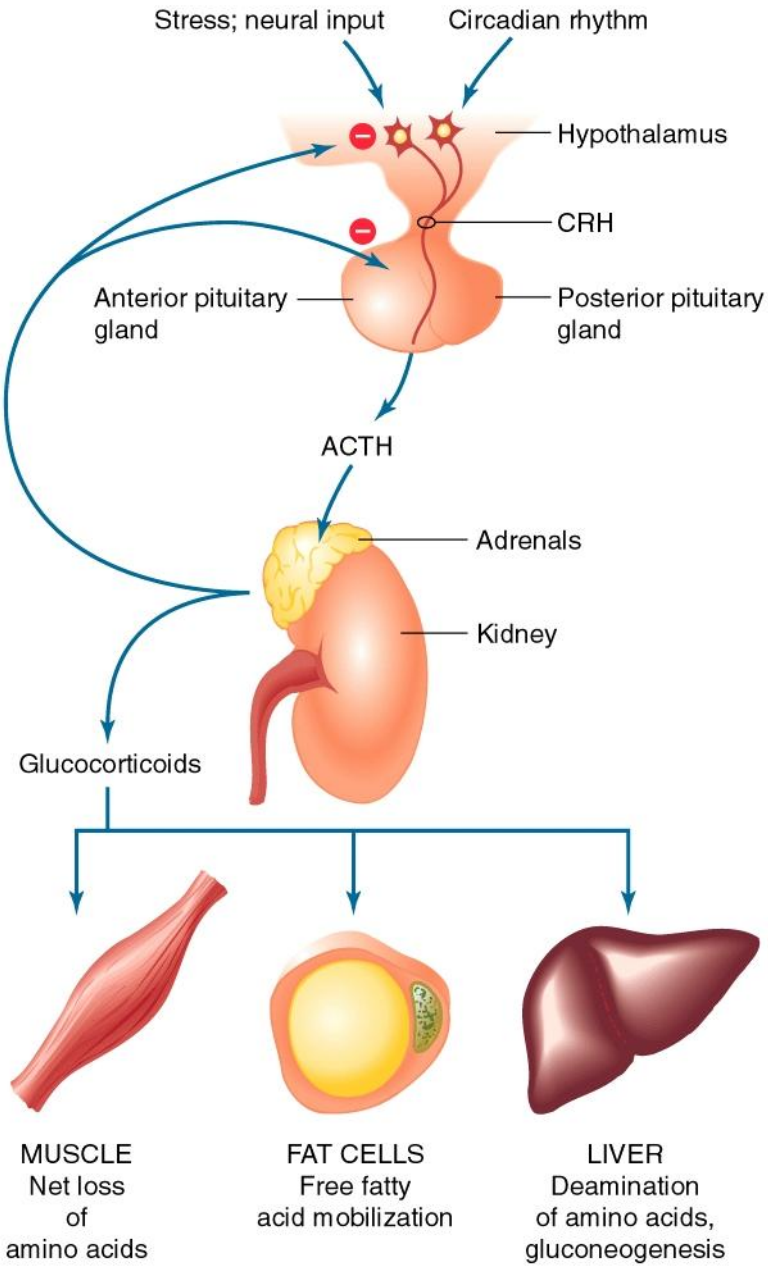

Higher center
Chromaffin cell
Nerve terminal
Sympathetic ganglion
Preganglionic fiber
Spinal cord
Acetylcholine
Epinephrine or norepinephrine
Blood vessel

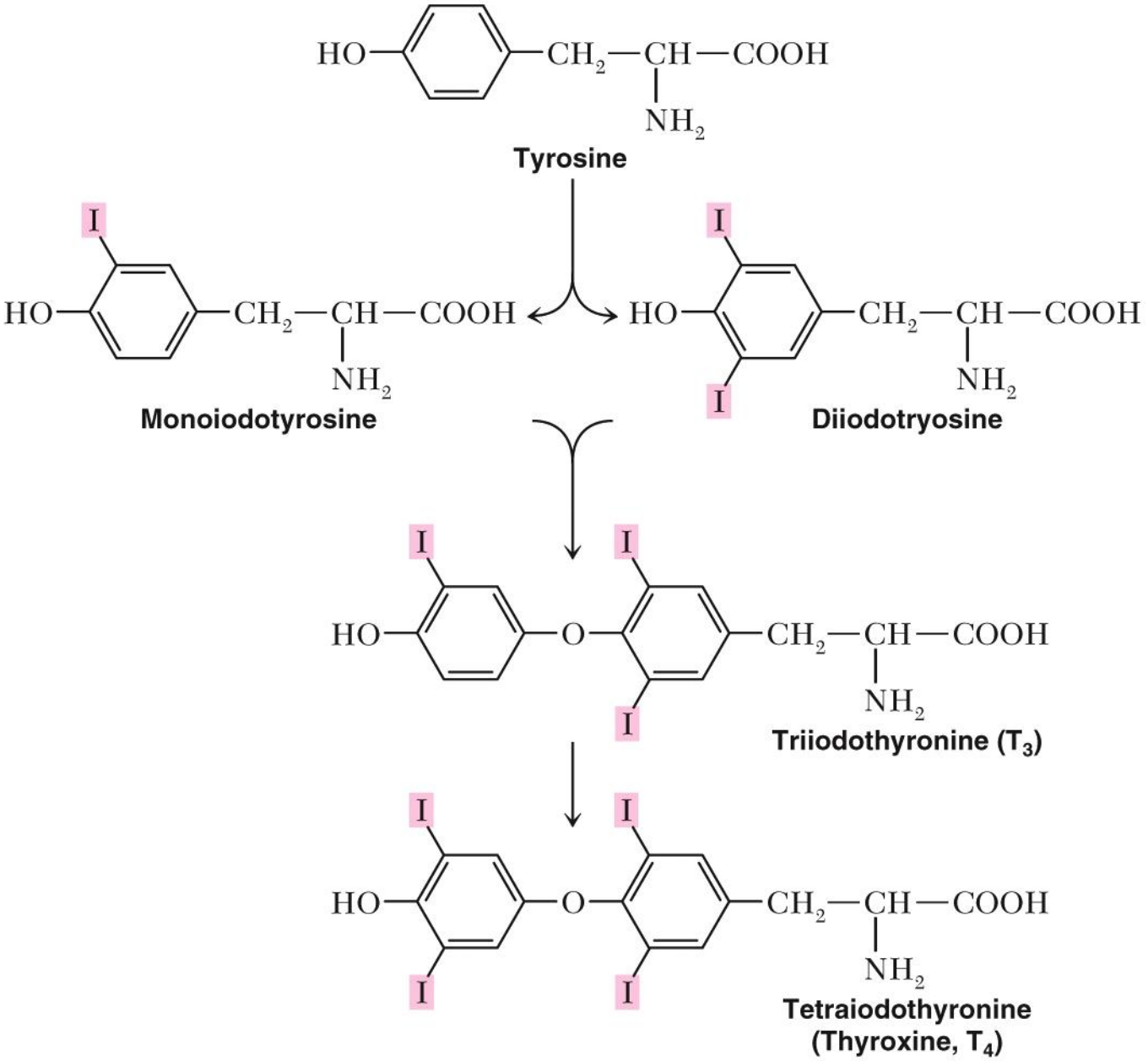

α_1
Phospholipase C
Phosphoinositides
IP_3 + DAG
Tissue response
β_1
β_2
α_2
Adenylate cyclase
ATP
cAMP
Tissue response

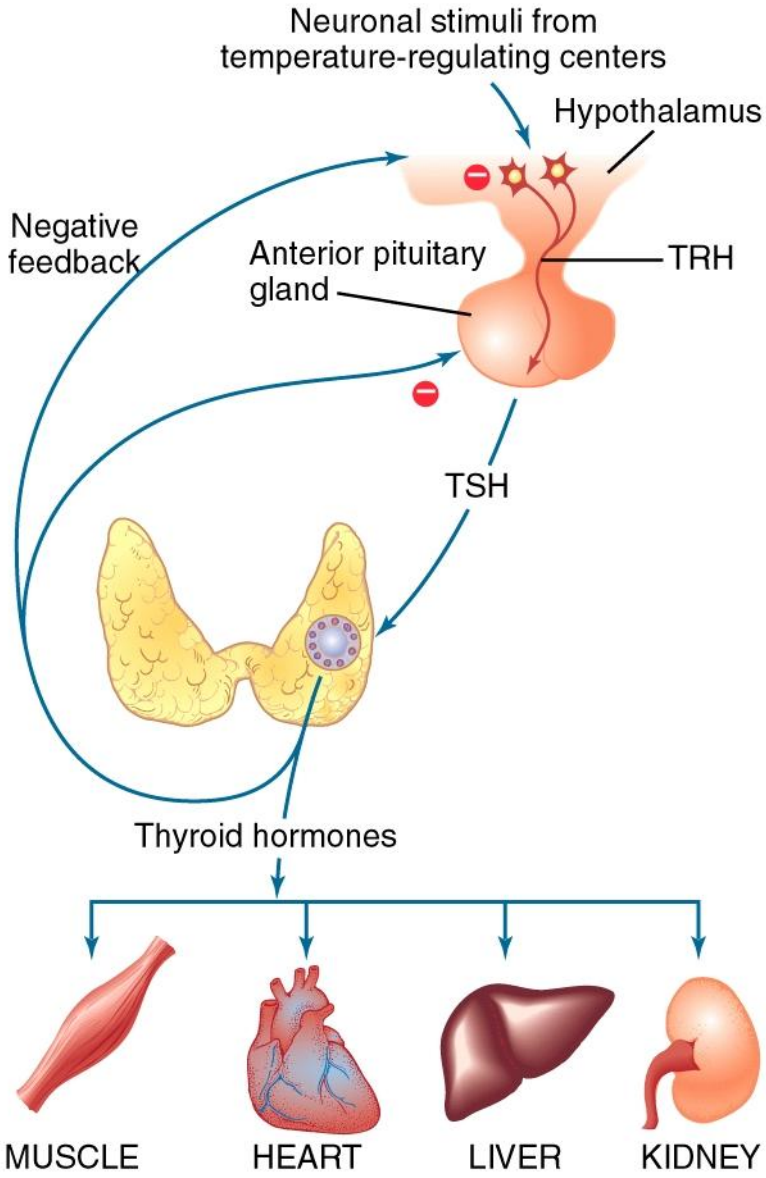

HO
Cholesterol
CH2OH
C=O
CH3
CH3
O
Progesterone


CH2OH
C=O
CH3
CH3
O
Progesterone
CH2OH
C=O
O
CH
HO
O
Aldosterone
O
Androstenedione
CH2OH
C=O
HO
OH
O
Cortisol

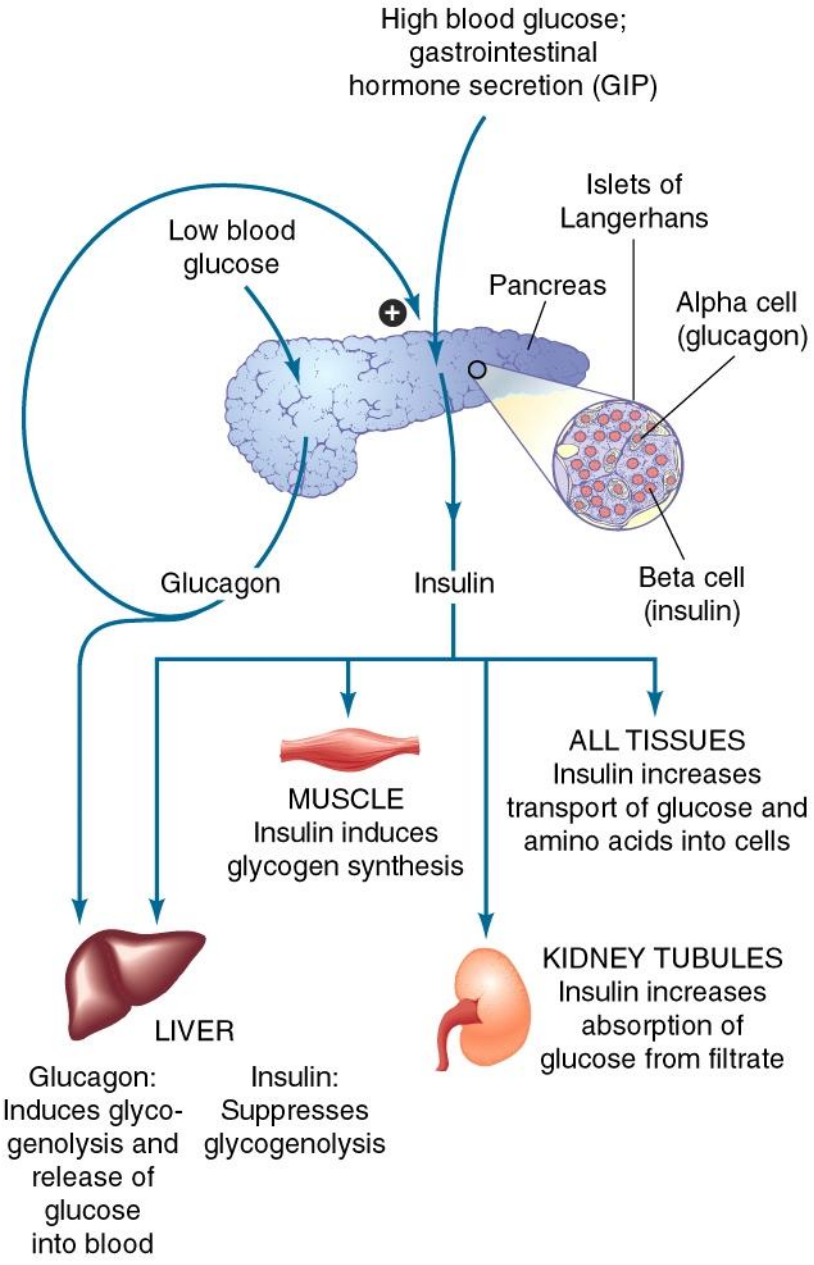

O
O
Androstenedione
O
HO
Estrone
OH
O
Testosterone
OH
HO
Estradiol

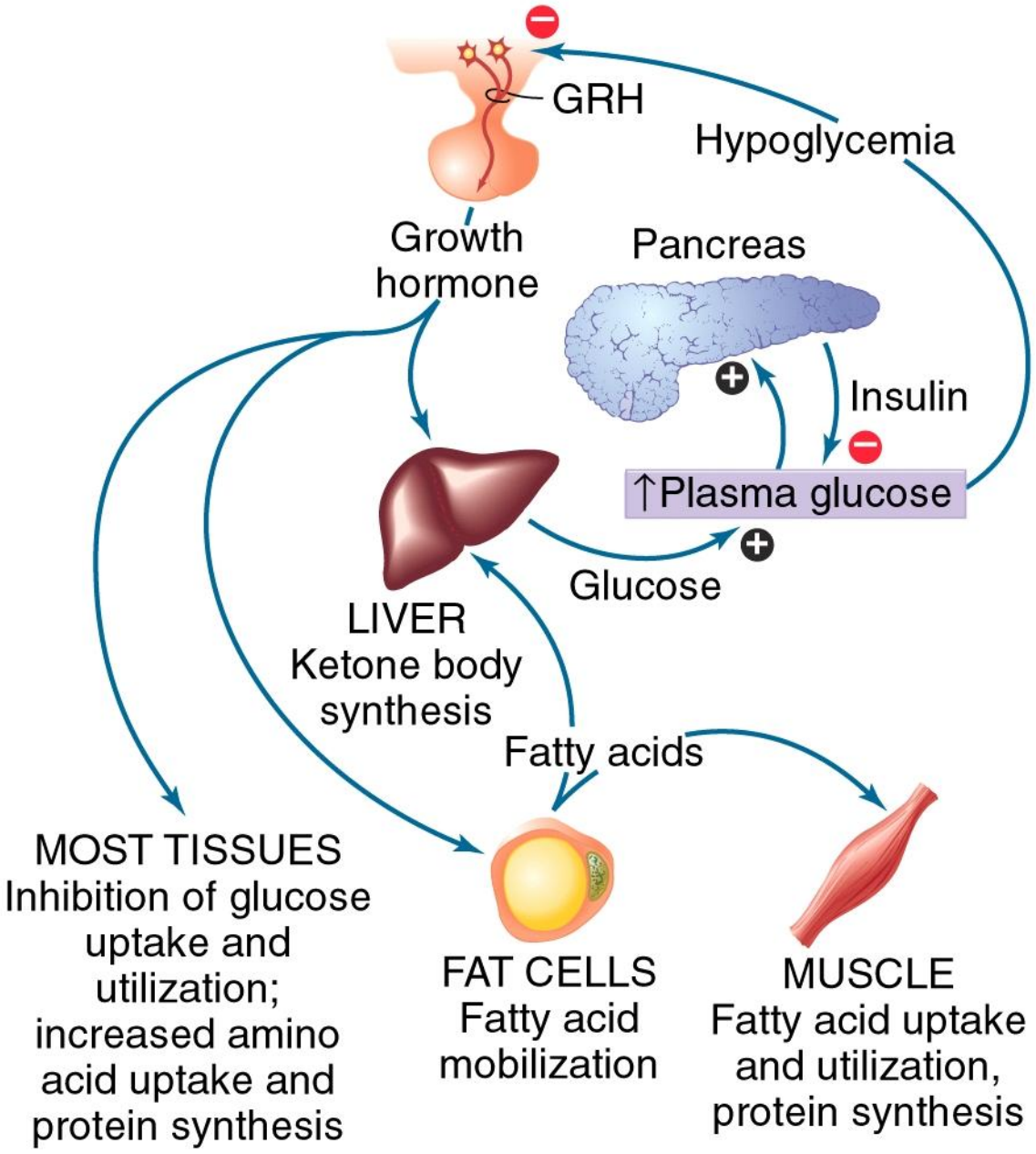

Stress; neural input
Circadian rhythm
Hypothalamus
CRH
Anterior pituitary gland
Posterior pituitary gland
ACTH
Adrenals
Kidney
Glucocorticoids
MUSCLE
Net loss of amino acids
FAT CELLS
Free fatty acid mobilization
LIVER
Deamination of amino acids, gluconeogenesis


HO
CH2—CH—COOH
NH2
Tyrosine
I
Monoiodotyrosine
Diiodotryosine
O
Triiodothyronine (T3)
Tetraiodothyronine
(Thyroxine, T4)



Increased oxygen consumption and heat production


High blood glucose; gastrointestinal hormone secretion (GIP)
Islets of Langerhans
Low blood glucose
Pancreas
Alpha cell (glucagon)
Glucagon
Insulin
Beta cell (insulin)
MUSCLE
Insulin induces glycogen synthesis
ALL TISSUES
Insulin increases transport of glucose and amino acids into cells
KIDNEY TUBULES
Insulin increases absorption of glucose from filtrate
LIVER
Glucagon: Induces glyco-genolysis and release of glucose into blood
Insulin: Suppresses glycogenolysis


GRH
Hypoglycemia
Growth hormone
Pancreas
Insulin
↑Plasma glucose
Glucose
LIVER
Ketone body synthesis
Fatty acids
MOST TISSUES
Inhibition of glucose uptake and utilization; increased amino acid uptake and protein synthesis
FAT CELLS
Fatty acid mobilization
MUSCLE
Fatty acid uptake and utilization, protein synthesis

“The Somogyi effect or phenomenon happens when you take insulin before bed and wake up with high blood sugar levels.

According to the theory of the Somogyi effect, when insulin lowers your blood sugar too much, it can trigger a release of hormones that send your blood sugar levels into a rebound high. It’s thought to be more common in people with type 1 diabetes than type 2 diabetes.”

https://www.healthline.com/health/diabetes/what-is-the-somogyi-effect

Table 9-8 Mammalian hormones involved in regulating water and electrolyte balance

Hormone	Tissue of origin	Structure	Target tissue	Primary action	Regulation
Antidiuretic hormone (ADH, vasopressin)	Posterior pituitary	Nonapeptide	Kidneys	Increases water reabsorption	Increased plasma osmotic pressure or decreased blood volume stimulates release
Atrial natriuretic peptide (ANP)	Heart (atrium)	Peptide	Kidneys	Reduces Na^+ and water reabsorption	Increased venous pressure stimulates release
Calcitonin	Thyroid (parafollicular cells)	Peptide	Bones, kidneys	Decreases release of Ca^{2+} from bone; increases renal Ca^{2+} and PO_4^{3-} excretion	Increased plasma Ca^{2+} stimulates secretion
Mineralocorticoids (e.g., aldosterone)	Adrenal cortex	Steroid	Distal kidney tubules	Promotes reabsorption of Na^+ from urinary filtrate	Angiotensin II stimulates secretion
Parathyroid hormone (PTH)	Parathyroid gland	Peptide	Bones, kidneys, intestine	Increases release of Ca^{2+} from bone; with calcitriol increases intestinal Ca^{2+} absorption; decreases renal Ca^{2+} excretion	Decreased plasma Ca^{2+} stimulates secretion

Modified in class

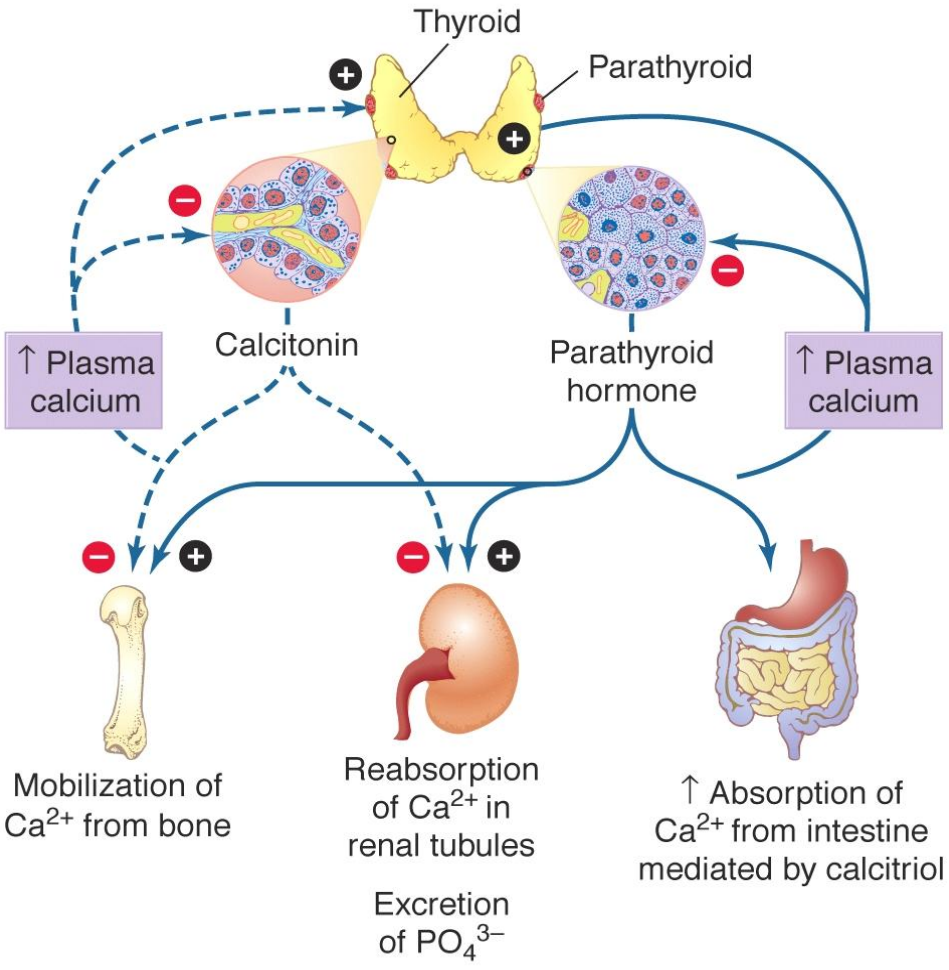
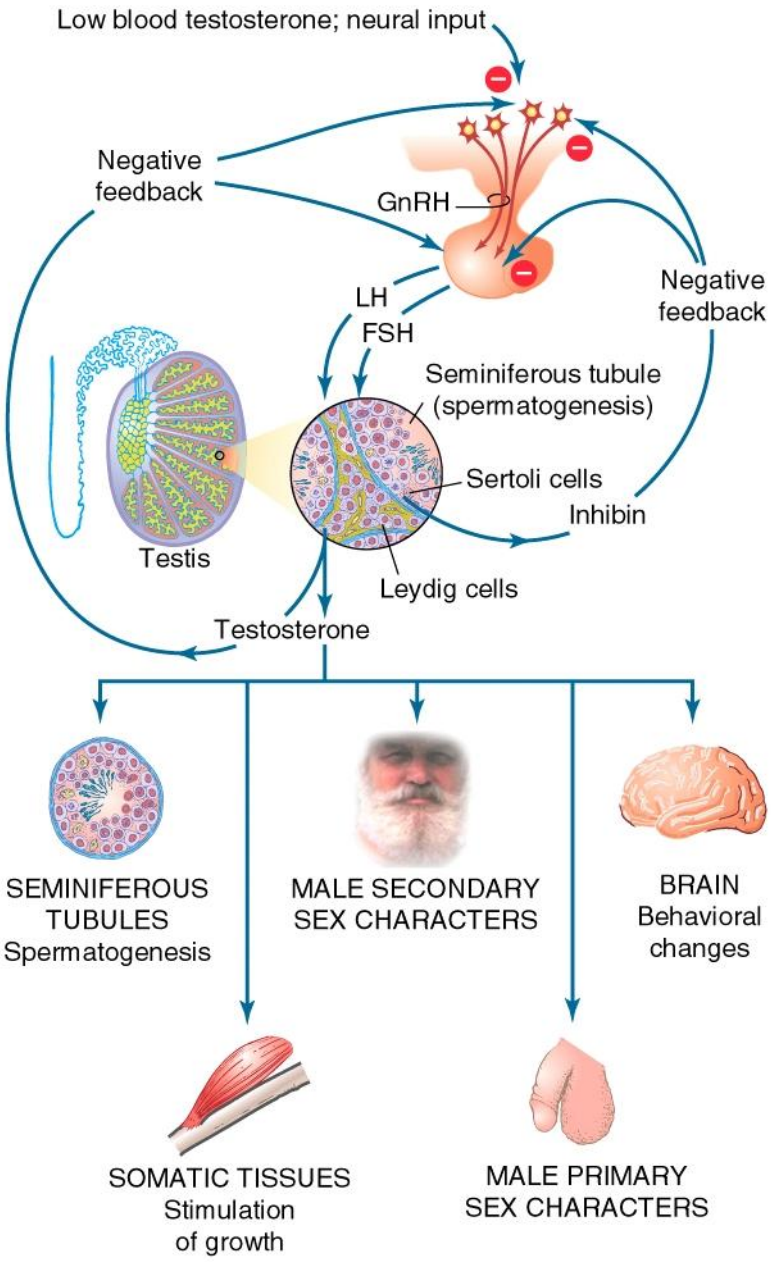
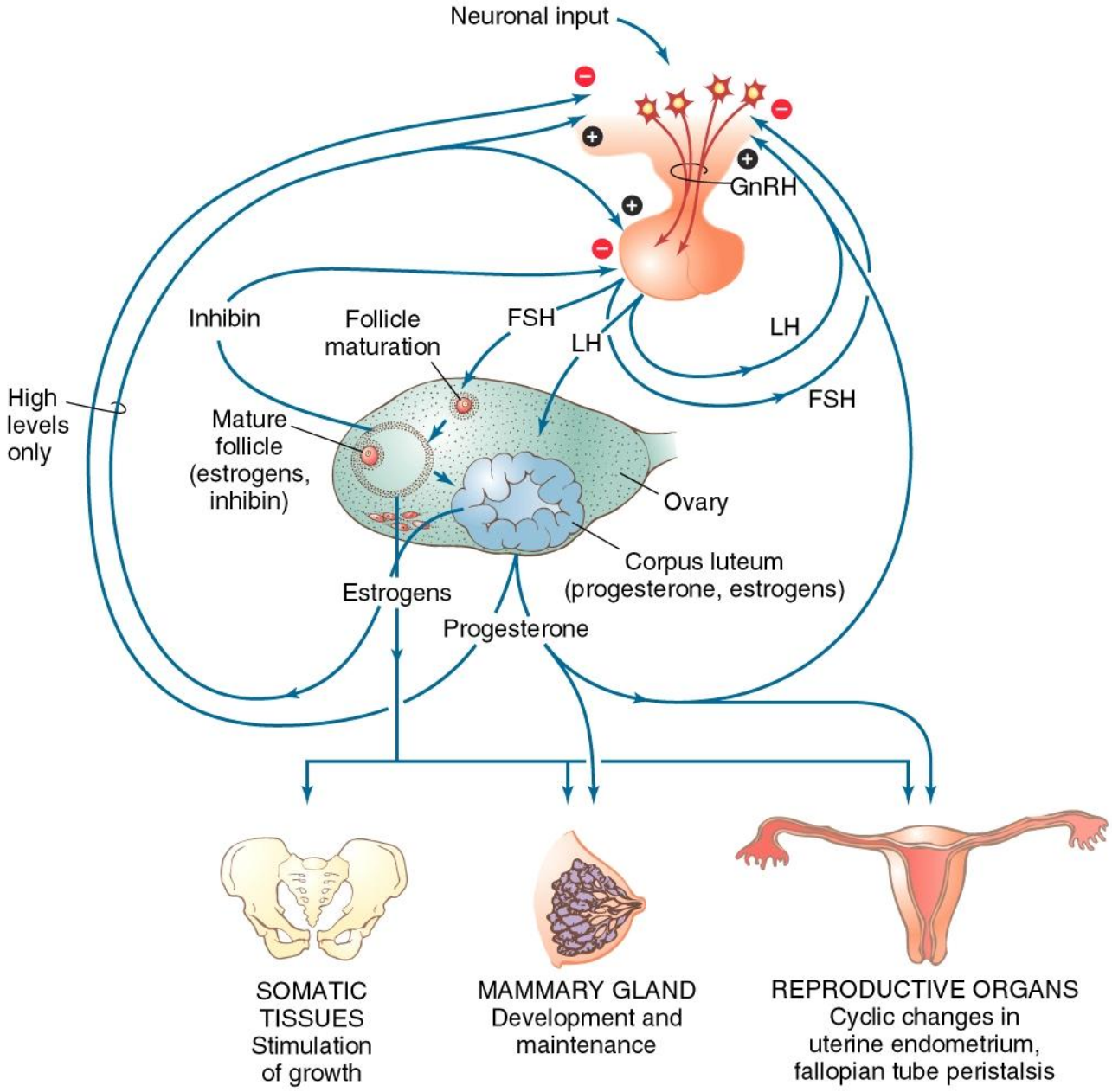
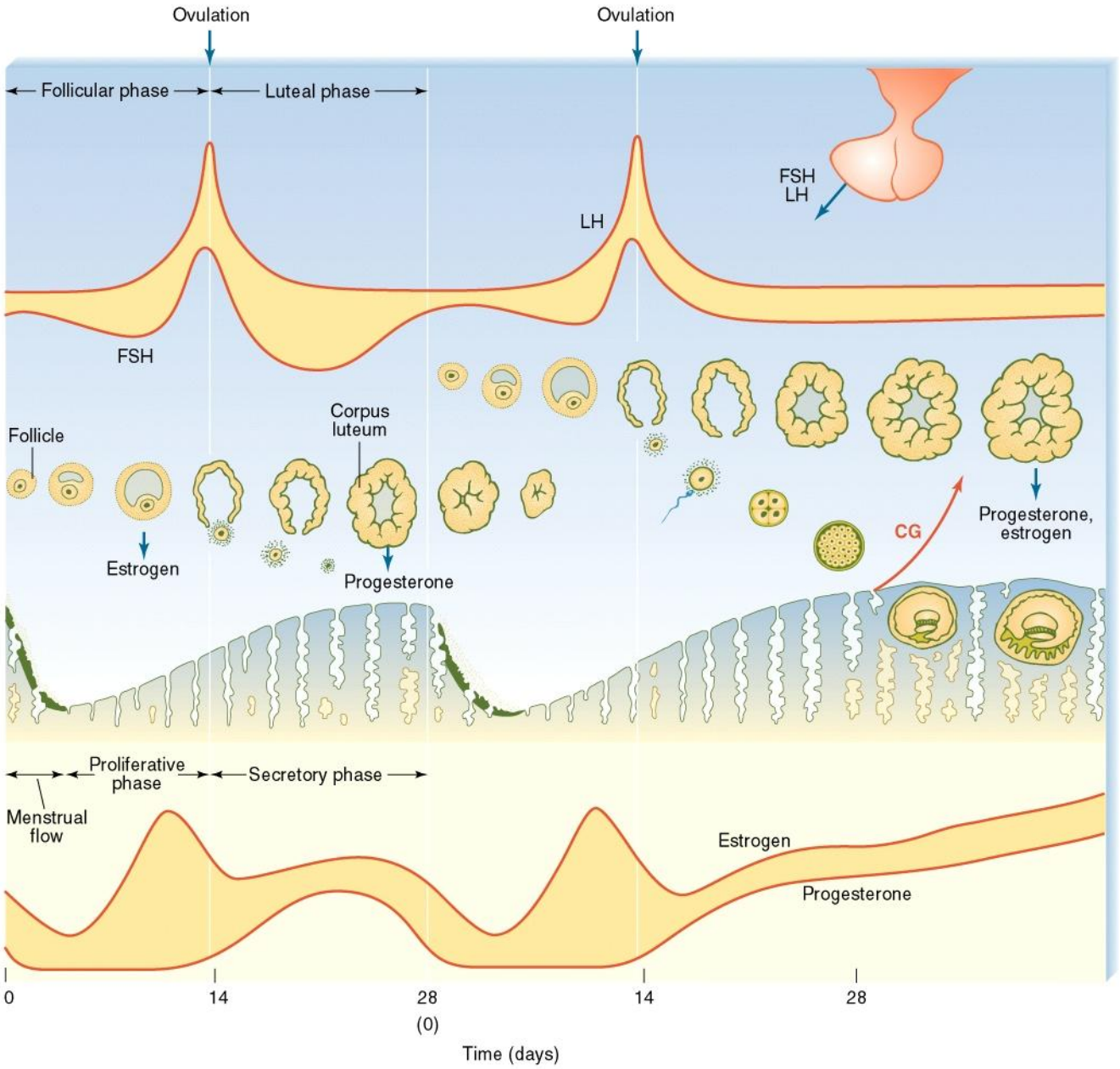


Table 9-9 Important mammalian reproductive hormones

Hormone	Tissue of origin	Structure	Target tissue	Primary action	Regulation
Primary sex hormones					
Estradiol-17β (estrogens)	Ovarian follicle, corpus luteum, adrenal cortex	Steroid	Most tissues	Promotes development and maintenance of female characteristics and behavior, oocyte maturation, and uterine proliferation	Increased FSH and LH levels stimulate secretion
Progesterone	Corpus luteum, adrenal cortex	Steroid	Uterus, mammary glands	Maintains uterine secretion; stimulates mammary duct formation	Increased LH and prolactin levels stimulate secretion
Testosterone (androgens)	Testes (Leydig cells), adrenal cortex	Steroid	Most tissues	Promotes development and maintenance of male characteristics and behavior and spermatogenesis	Increased LH level stimulates secretion
Other Hormones					
Oxytocin	Posterior pituitary	Nonapeptide	Uterus, mammary glands	Promotes smooth muscle contraction and milk ejection	Cervical distention and suckling stimulate release; high progesterone inhibits release
Prolactin (PL)	Anterior pituitary	Peptide	Mammary glands (alveolar cells)	Increases synthesis of milk proteins and growth of mammary glands; elicits maternal behavior	Continuous secretion of PL-inhibiting hormone (PIH) normally blocks release; increased estrogen and decreased PIH secretion permit release


Low blood testosterone; neural input
Negative feedback
GnRH
Negative feedback
LH
FSH
Seminiferous tubule (spermatogenesis)
Sertoli cells
Inhibin
Testis
Leydig cells
Testosterone
SEMINIFEROUS TUBULES Spermatogenesis
MALE SECONDARY SEX CHARACTERS
BRAIN Behavioral changes
SOMATIC TISSUES Stimulation of growth
MALE PRIMARY SEX CHARACTERS


Neuronal input
GnRH
Inhibin
Follicle maturation
FSH
LH
LH
FSH
High levels only
Mature follicle (estrogens, inhibin)
Ovary
Corpus luteum (progesterone, estrogens)
Estrogens
Progesterone
SOMATIC TISSUES
Stimulation of growth
MAMMARY GLAND
Development and maintenance
REPRODUCTIVE ORGANS
Cyclic changes in uterine endometrium, fallopian tube peristalsis


Ovulation
Ovulation
Follicular phase
Luteal phase
FSH
LH
FSH
LH
Follicle
Corpus luteum
Estrogen
Progesterone
CG
Progesterone, estrogen
Proliferative phase
Secretory phase
Menstrual flow
Estrogen
Progesterone
0
14
28
(0)
14
28
Time (days)

https://en.wikipedia.org/wiki/Pap_test

The **Papanicolaou test** (abbreviated as **Pap test**, also known as **Pap smear** (AE),[1] **cervical smear** (BE), **cervical screening** (BE),[2] or **smear test** (BE)) is a method of cervical screening used to detect potentially precancerous and cancerous processes in the cervix (opening of the uterus or womb) or, more rarely, anus (in both men and women).

https://en.wikipedia.org/wiki/Contraceptive_trials_in_Puerto_Rico

https://magazine.jhsph.edu/2022/brief-history-abortion-us

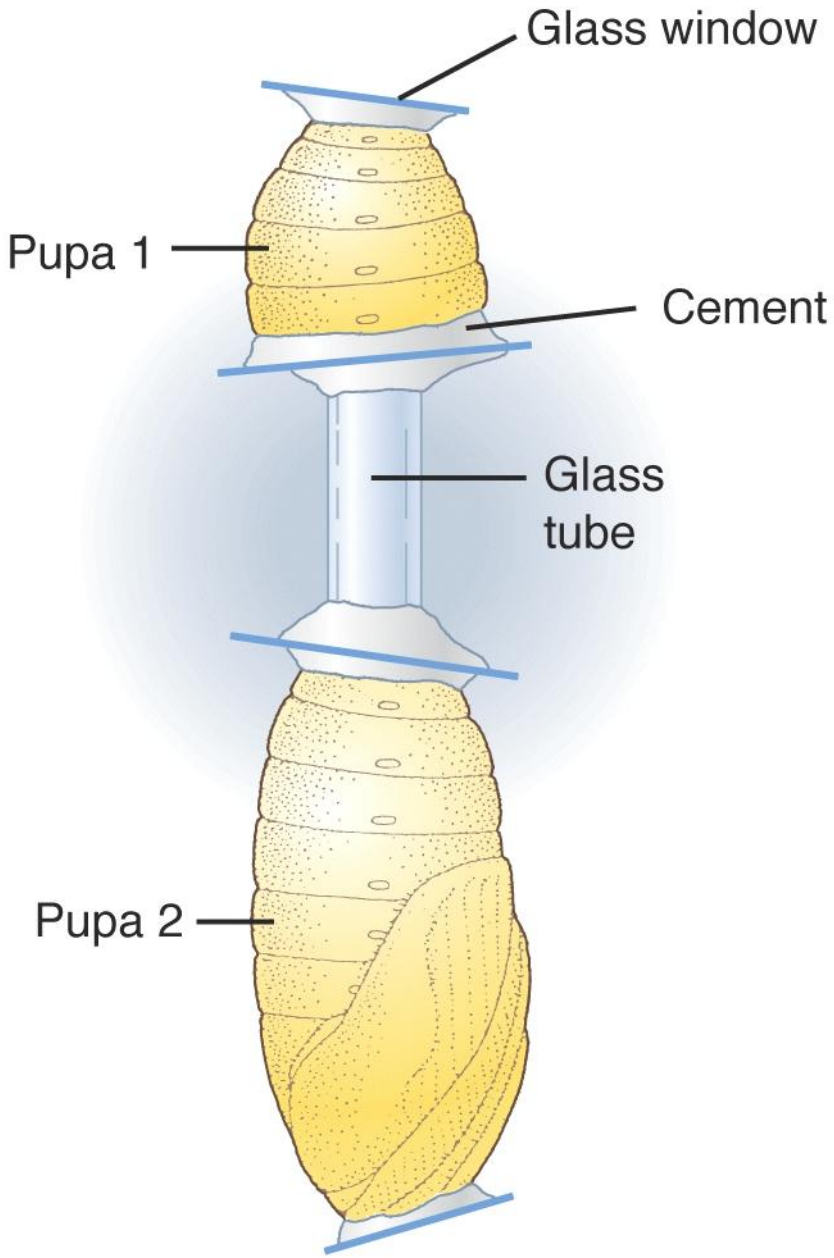
https://pubmed.ncbi.nlm.nih.gov/12178868/

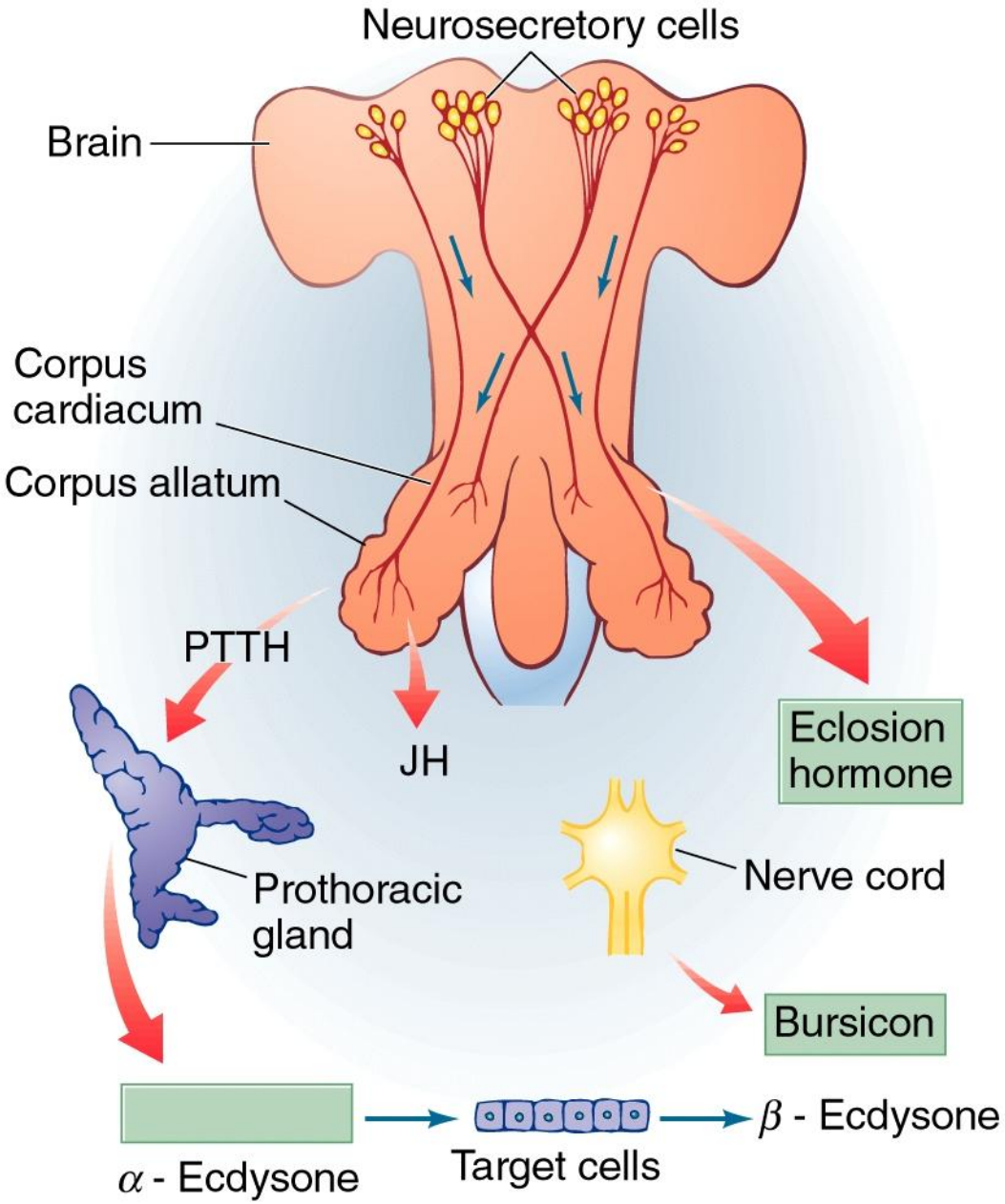
Most people will have a period 14 to 16 days after ovulation, regardless of the length of their overall cycle. Although eggs are only available for fertilization for about 24 hours after being released from your ovaries, sperm can live for five days. For that reason, people using the rhythm method should avoid sexual intercourse for at least five days before and three days after ovulation.

Generally speaking, you're most fertile:

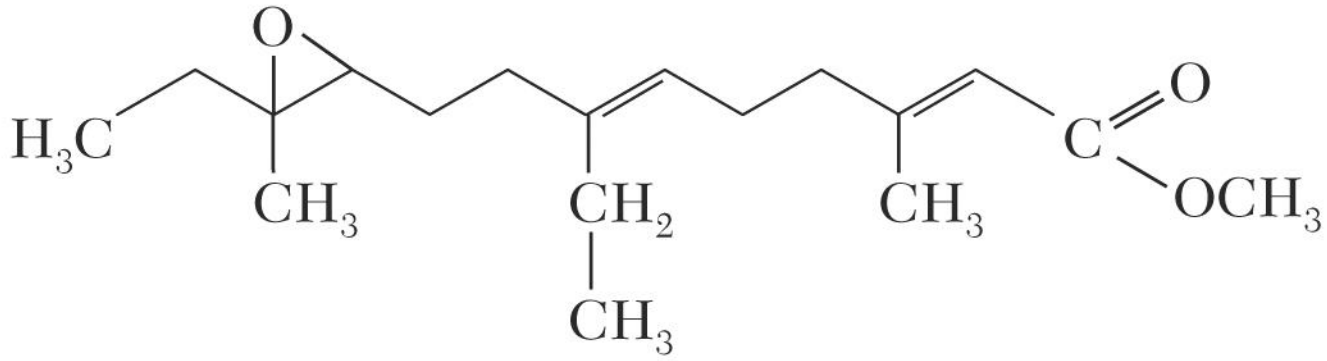
- In the days just before ovulation.
- The day of ovulation.
- Within 24 hours of ovulation.

https://my.clevelandclinic.org/health/articles/17900-rhythm-method


Glass window
Pupa 1
Cement
Glass
tube
Pupa 2

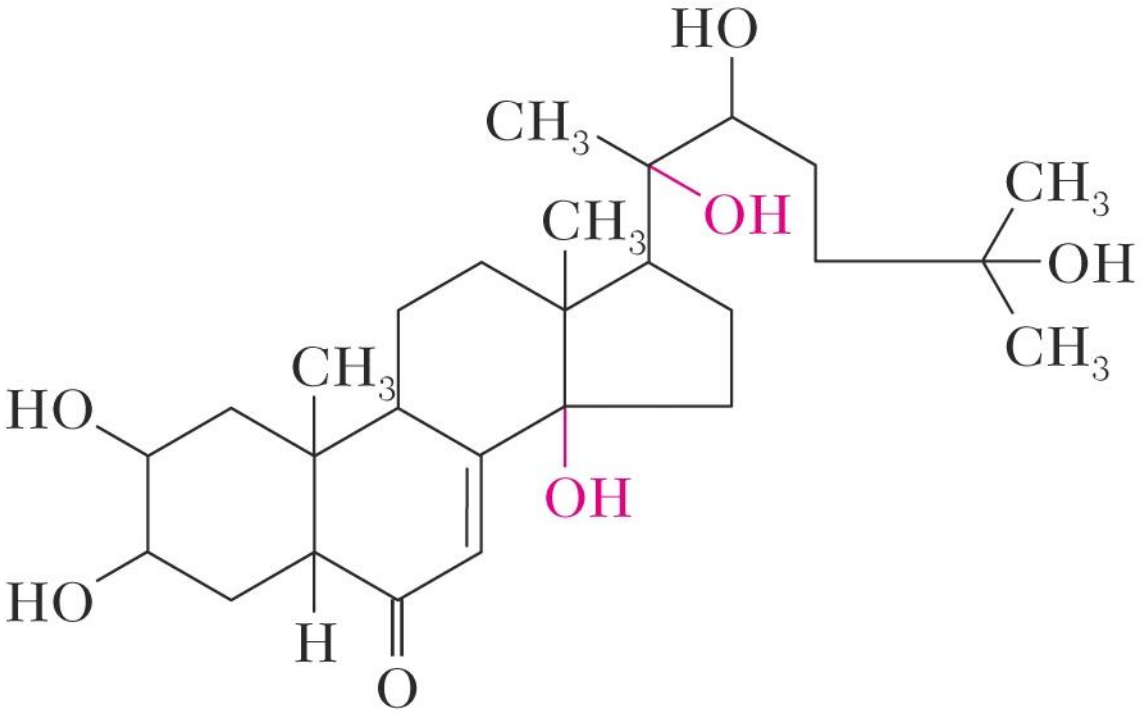

Neurosecretory cells
Brain
Corpus cardiacum
Corpus allatum
PTTH
JH
Eclosion hormone
Prothoracic gland
Nerve cord
Bursicon
α - Ecdysone
Target cells
β - Ecdysone

(a)

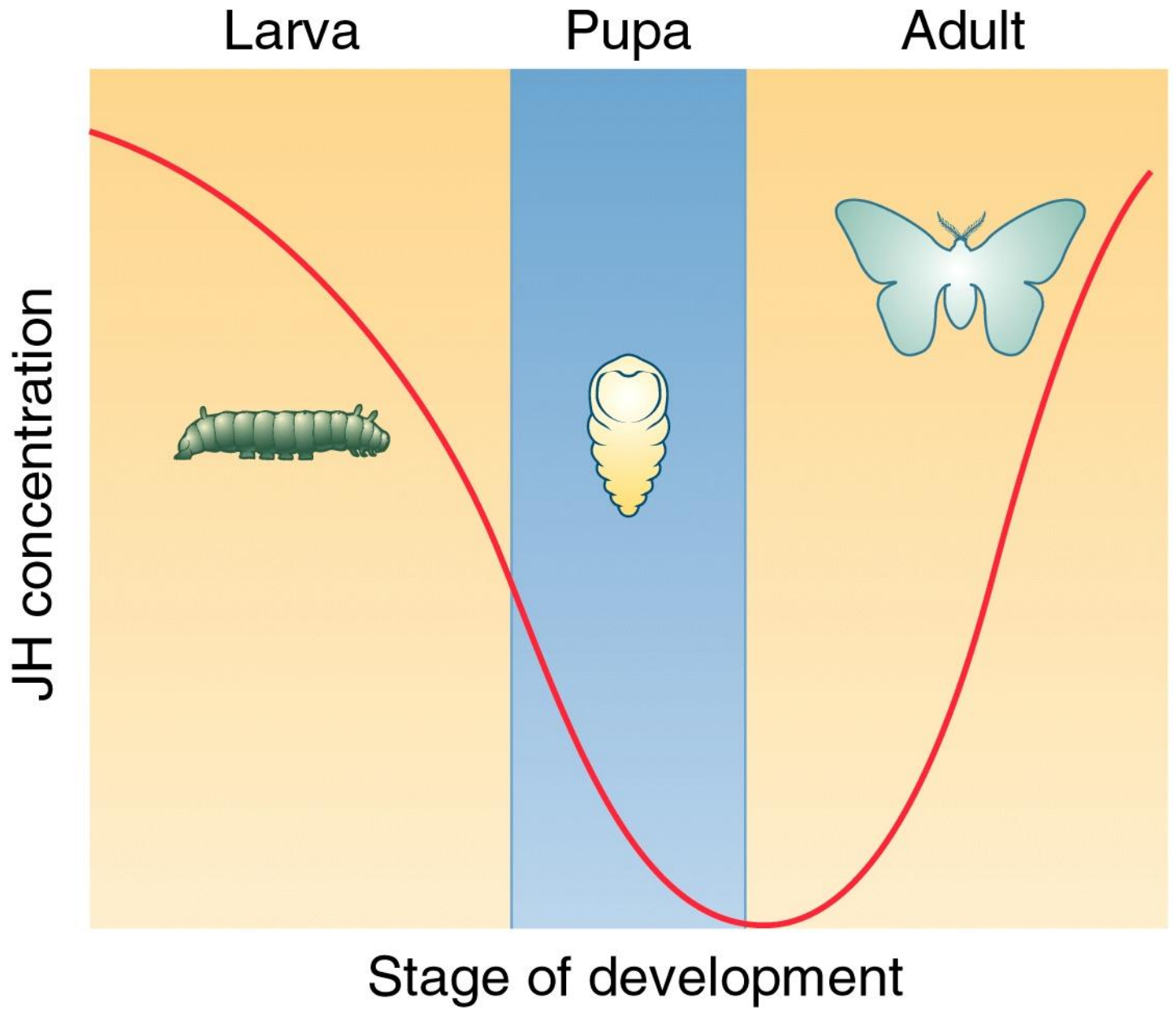


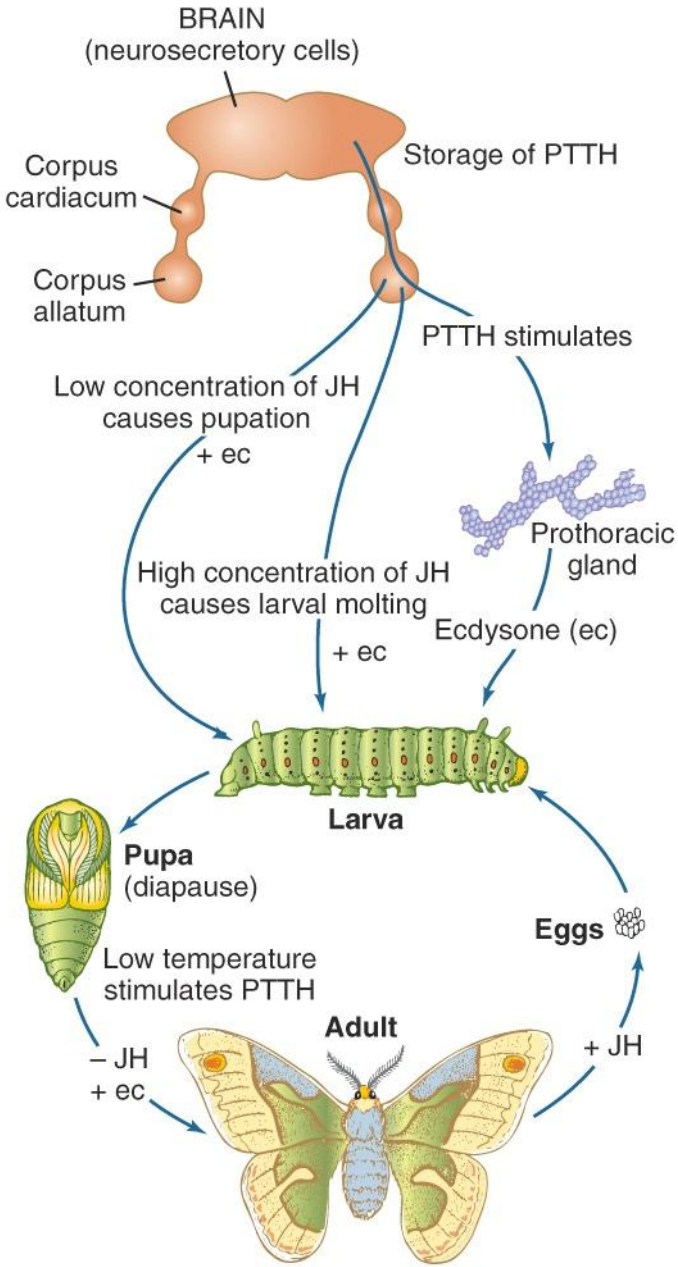
Juvenile hormone

(b)



β-Ecdysone


Larva
Pupa
Adult
JH concentration
Stage of development


BRAIN
(neurosecretory cells)
Storage of PTTH
Corpus
cardiacum
Corpus
allatum
PTTH stimulates
Low concentration of JH
causes pupation
+ ec
Prothoracic
gland
High concentration of JH
causes larval molting
+ ec
Ecdysone (ec)
Larva
Pupa
(diapause)
Eggs
Low temperature
stimulates PTTH
Adult
– JH
+ ec
+ JH