

Lipid-soluble hormones

Steroid hormones aldosterone, cortisol, testosterone, oestrogen

Tyroid hormones T3 & T4

Gases nitric oxide (hormone & neurotransmitter)

1. lipid-soluble hormone **diffuses** into cell
2. **activated receptor-hormone complex** alters **gene expression**
3. newly formed **mRNA** directs synthesis of **specific proteins** on **ribosomes**

- increase **solubility** in blood
- **slow rate of hormone loss** in urine
- provide a ready **reserve** of hormone

Hypothalamus & pituitary gland

the hypothalamus is the major link between nervous & endocrine systems, & it **regulates** the pituitary gland.

the pituitary gland is pea-shaped & secretes **7 hormones**, it had two anatomically/functionally distinct portions, the **anterior pituitary** is **stimulated** by **releasing** hormones from **hypothalamus** & is **suppressed** by inhibiting them.

Pineal gland

small endocrine gland attached to roof of third ventricle, secretes **melatonin** which contributes to maintaining **biological clock** & more is secreted in **darkness** - gland is very developed in nocturnal animals.

Parathyroid glands

Hormone + source	control	Action
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Parathyroid glands (cont)

PTH	low from blood	increases blood Ca^{2+} & Mg^{2+} levels & decreases blood Ca^{2+} levels
chief cells	stimulate secretion (& vice versa)	bone resorption by osteoclasts, increases Ca^{2+} reabsorption * HPO_4^{2-} excretion by kidneys, promotes formation of calcitriol (vit D active form) which increases rate of dietary Ca^{2+} & Mg^{2+} absorption.

two [airs of small, round masses of tissue attached to posterior surface of lateral lobes of thyroid gland

Adrenal glands

Hormone + source	control	Action
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a) cortex hormones

1. mineralocorticoids from zona glomerulosa cells	increased blood K^+ level & angiotensin II stimulate secretion	increase blood levels of Na^+ & water, decrease blood level of K^+
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Adrenal glands (cont)

2. glucocorticoids from zona fasciculata cells	ACTH stimulates release; corticotropin-releasing hormone promotes ACTH secretion in response to stress & low blood levels of glucocorticoids	increase protein breakdown (except in liver), stimulate gluconeogenesis & lipolysis, provide resistance to stress, dampen inflammation, depress immune responses
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3. androgens from zona reticularis cells	ACTH stimulates secretion	assist in early growth of axillary & pubic hair in both sexes, in females - contribute to libido & are source of oestrogen after menopause
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b) medulla hormones

1. adrenaline/noradrenaline from chromaffin cells	sympathetic preganglionic neurons release ACh which stimulates secretion	enhances effects of sympathetic division of autonomic nervous system during stress
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two (one superior to each kidney - suprarenal glands) with two structurally/functionally distinct regions - medulla & cortex.



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Page 1 of 4.

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Water-soluble hormones			Anterior pituitary (cont)			Pancreas		
Amine hormones	adrenaline, noradrenaline, dopamine histamine	(tyrosine) (histidine)	hGH	liver	stimulates liver, muscle, cartilage & bone to synthesise & secrete insulin-like growth factors (IGFs) which promote growth of body cells, protein synthesis, tissue repair, lipolysis & elevates blood [glucose].	Hormone + source	control	Action
	serotonin & melatonin	(tryptophan)				glucagon from alpha cells of pancreatic islets	decreased blood level of glucose, exercise, & mainly protein meals stimulate secretion, somatostatin (growth hormone) & insulin inhibits.	raises blood glucose by accelerating glycogen breakdown into glucose in liver (glycogenolysis), converting other nutrients into glucose in liver (gluconeogenesis) & releasing glucose in blood
Peptide/Protein hormones	amino acid polymers 3-49aa/50-200aa (peptide) oxytocin, ADH (protein) human growth, insulin		TSH	thyroid gland	stimulates synthesis & secretion of thyroid hormones	insulin from beta cells of pancreatic islets	increased blood level of glucose, ACh, arginine & leucine, glucagon, GIP, hGH, & ACTH stimulate, somatostatin inhibits	lowers blood glucose by accelerating transport of glucose into cells, converting glucose into glycogen & decreasing glycogenolysis & gluconeogenesis, increases lipogenesis & stimulates protein synthesis
eicosanoid hormones	derived from arachidonic acid/membrane lipids. Prostaglandins & leukotrienes. Local hormones secreted by all cells (except RBCs).		FSH	ovaries & testes	initiates development of oocytes & induces ovarian secretion of estrogens/ stimulates testes to produce sperm			
1. hormone binding to receptor activates G protein, activating adenylate cyclase 2. activated adenylate cyclase converts ATP → cAMP 3. cAMP activates protein kinases 4. activated protein kinases phosphorylate cellular proteins 5. millions of phosphorylated proteins cause reactions that produce physiological responses			LH	ovaries & testes	stimulates secretion of oestrogen & progesterone, ovulation & formation of corpus luteum/ stimulates testes to produce testosterone			
Anterior pituitary			prolactin (PRL)	mammary glands	promotes milk production			
Hormone	Target tissues	Action	ACTH	adrenal cortex	stimulates secretion of glucocorticoids			
			MSH	brain	exact role unknown, may influence brain activity, excess can cause skin darkening			



Pancreas (cont)

somato- pancreatic inhibits
statin from polypeptide secretion of
delta cells inhibits insulin &
of glucagon,
pancreatic slows
islets absorption of
nutrients
from GI tract

pancreatic meals with inhibits
polype- protein, somatostatin
ptide from fasting, secretion,
F cells of exercise & gallbladder
pancreatic acute hypogl- contraction
islets ycemia & secretion
stimulate, of pancreatic
somatostatin & digestive
elevated blood enzymes
glucose inhibit

located posterior & inferior to stomach, both
endocrine & exocrine gland.

Hormone interactions

permissive effect

requires recent/simultaneous exposure
to 2nd hormone

synergistic effect

two hormones have greater impact than
individually

antagonistic effect

two hormones have opposing actions

cell target responsiveness is dependent on
the [hormone] in blood, number of receptors
on target cell, & the influences of other
hormones.

Thyroid gland

Hormone + source	control	Action
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Thyroid gland (cont)

T3 & T4	secretion	increase
from	increased by	basal
follicular	TRH which	metabolic
cells	stimulates	rate, stimulate
	release of	protein
	TSH in	synthesis,
	response to	increase
	low thyroid	glucose &
	hormone	fatty acid use
	levels, low	for ATP
	metabolic	production,
	rate, cold,	increase
	pregnancy &	lipolysis,
	high altitudes.	enhance
	TRH/TSH	cholesterol
	secretions	excretion,
	inhibited by	accelerate
	high thyroid	body growth,
	hormone	contribute to
	levels & high	nervous
	iodine level	system
		development

calcitonin	high blood	lowers blood
(CT)	Ca ²⁺ levels	levels of
from	stimulate	Ca ²⁺ &
parafolli-	secretion (&	HPO ₄ ²⁻ by
cular	vice versa)	inhibiting
cells		bone
		resorption by
		osteoclasts &
		by accele-
		rating calciu-
		m/phosphate
		uptake into
		bone extrac-
		ellular matrix

butterfly-shaped, located inferior to larynx &
anterior to trachea. together with hGH &
insulin, thyroid hormones accelerate growth
(particularly in nervous/skeletal systems)

Thymus

- located superiorly to heart
- secretes **thymosin**
- promotes proliferation & maturation of T
cells (lymphocyte that destroys microorga-
nisms & foreign substances)

Testes

testos	stimulates descent of testes
terone	before birth, regulates spermatog- enesis, promotes development & maintenance of male secondary sex characteristics

inhibin	inhibits secretion of FSH from anterior pituitary
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- oval glands in scrotum
- main hormone produced & secreted is
testosterone

Posterior pituitary

Hormone	Target tissues	control	action
oxytocin	uterus, mammary glands	neuros- ecretory cells of hypoth- alamus secrete OT in response to uterine distention & stimu- lation of nipples	stimulate contra- ction of smooth muscle cells of uterus during childbirth stimulate contra- ction of myoepi- thelial cells in mammary glands to cause milk ejection



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Page 3 of 4.

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Posterior pituitary (cont)

ADH	kidneys, arterioles, sudoriferous (sweat) glands	neurosecretory cells of hypothalamus secrete ADH in response to elevated blood osmotic pressure, dehydration, loss of blood volume, pain or stress; inhibitors of ADH are low blood osmotic pressure, high blood volume & alcohol	conserves water by decreasing urine volume, decreases water loss through perspiration, raises BP by constricting arterioles
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does not synthesise hormones, stores & releases oxytocin & ADH

Ovaries

Hormone	action
estrogens & progesterone	together with gonadotropic hormones of anterior pituitary, regulate female reproductive cycle & oogenesis, maintain pregnancy, prepare mammary glands for lactation & promote development & maintenance of female secondary sex characteristics

Ovaries (cont)

relaxin	increases flexibility of pubic symphysis during pregnancy, helps dilate uterine cervix during labour & delivery.
inhibin	inhibits secretion of FSH from anterior pituitary

- paired oval bodies in the female pelvic cavity
- produce several steroid hormones

Other

skin	vit D - mineral homeostasis
liver	angiotensinogen - increases BP
small intestine	secretin - increases pancreatic juice secretion
heart	ANP - decreases bp
stomach	gastrin - increases stomach motility
kidney	EPO - increases RBC production



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