

Name

KEY

ENDOCRINE SYSTEM - Ch45

A. Exocrine vs. endocrine glands - chemical signaling by hormones from ductless  
↳ secrete stuff through ducts into cavities or surfaces (salivary)

B. Other secretory processes - a) paracrine - affect local neighbor cells

p. 976 Fig 45.2

b) autocrine - affect <sup>same</sup> cell that secretes them

c) synaptic - neurotransmitters

d) neuroendocrine - neurot. diffuse into blood + affect targets anywhere in body

C. Other "glands" -

D. Hormones -

Fig 45.6 1. Protein - peptide - polar - act as signal molecules for 1<sup>st</sup> + 2<sup>nd</sup> messenger systems

p. 979  
Fig 45.7 2. Steroid - lipid - non-polar - directly regulate gene expression by forming hormone-receptor complex acting as a gene activator (see CH 18 p. 354)

E. Feedback -

F. Negative feedback - loop where response reduces initial stimulus

G. Positive feedback -  $\Delta$  in variable amplifies the  $\Delta$

H. Antagonistic pairs of hormones -  $\uparrow$  in one causes inhibition of other or reversal of its effects

I. Target tissues/target cells - tissue/cells being acted on

Draw + outline Feed back loops

Include for each step:

- a) hormone produced ~~by~~ + gland
- b) hormone affected (and/or result)
- c)  $\oplus$  or  $\ominus$  feedback

- 1) calcium in blood
- 2) glucose in blood
- 3) Muscle growth + Androgens (including anabolic)

Homk:

- ① memorize p. 899
- ② p. 912 Challenge Q's

Endocrine Objectives

- ① hormones, functions, site of origin
- ② Protein vs steroid
- ③ Feedback + examples

<u>Hormone</u>	<u>Gland Prod</u>	<u>Gland Control</u>	<u>Function</u>	<u>Hyper</u>	<u>Hypo</u>
FSH-Follicle stimulating hormone	Pituitary	hypothalamus	Stimulates ovarian follicle development / spermatogenesis in males	symptoms of menopause	infertility
TSH-Thyroid stimulating hormone	Pituitary	hypothalamus	stimulates thyroid to produce hormones	underactive thyroid - Graves disease-nervous, weight loss, lack of sleep	overactive thyroid- Cretinism-unproportional body parts
ACTH-adrenocorticotrophic hormone	Pituitary	hypothalamus	stimulates production of hormones in the adrenal glands (used in treatments of arthritis, asthma, and allergies)	Cushings disease-excess fat deposits in upper body, facial hair, high glucose levels	Addisons disease- can not maintain normal glucose levels, weak, sluggish, death w/o treatment
Growth	Pituitary	hypothalamus	directly stimulates fat cell growth, indirectly stimulates liver hormones to increase bone growth and muscle growth	Giantism & Acromegaly- overgrowth of bone and connective tissue, course features	growth retardation
Prolactin	Pituitary	hypothalamus	stimulates milk production	tumors in females, breast development in males	no milk production
Thyroxine	Thyroid	hypothalamus	Regulates the rate of metabolism in the body.	Nervousness, irritable, weight loss. Sometimes eyes protrude (Graves). Goiters	same as TSH in children, adults-weight gain, puffy skin, slower mental activity
Parathormone-parathyroid hormone	Parathyroid		Regulates calcium and phosphate metabolism	removal of calcium from bones to point of brittleness	skeletal muscles become hypersensitive and contract violently
LH-luteinizing hormone	Pituitary	hypothalamus	regulates the menstrual cycle maintains development of corpus lutea / stimulates production of testosterone in males	gonadal failure	cessation of menstrual cycle, cessation of sperm production
Adrenaline	Adrenal	sympathetic nervous system	Prepares body to cope with stress, converts glycogen to glucose, vasodilator	hyperactive	can't react to stressful situations
Cortisol	Adrenal	pituitary	Affects metabolism, affects synthesis of glucose in liver	same as ACTH	same as ACTH

Insulin	Pancreas	Pancreas	Increases the rate of transport of glucose through cell membranes, When glucose levels are high, beta cells are stimulated to secrete insulin. In liver and skeletal muscle, promotes conversion of glucose to glycogen, in fatty tissue-promotes conversion of glucose to fat. Increases the rate of oxidation of glucose in cells.	Diabetic shock-hypoglycemia-not enough sugar in blood	diabetes-too much sugar in blood
Glucagon	Pancreas	Pancreas	Opposite of insulin - Increases blood glucose level. When supply of liver glycogen is exhausted, glucagon causes conversion of amino acids and fatty acids to glucose.	No sugar reserves	hypoglycemia-low blood sugar levels
Testosterone - male	Testis	hypothalamus	development of secondary male sex traits	male pattern baldness, breast development, aggressiveness, facial hair development of secondary	impairs sexual activity
Testosterone- female	Ovary	hypothalamus		male sex traits	
Estrogen-female	Ovary-follicle	hypothalamus	Initiate building of the uterine lining / development of secondary female sex traits	decreased sexual functioning	
Estrogen-male	Adrenal	hypothalamus	regulates bone growth	enhances secondary female sex traits	impairs ability to control semen production-too much decreasing sperm production /
Progesterone	Ovary-corporus luteum	hypothalamus	promote continued growth of uterine lining		
Anti-diuretic hormone	Pituitary	hypothalamus	Increases the permeability of the collecting duct so more water is reabsorbed into the bloodstream	high blood pressure-hypertension	more urine is formed-dehydration

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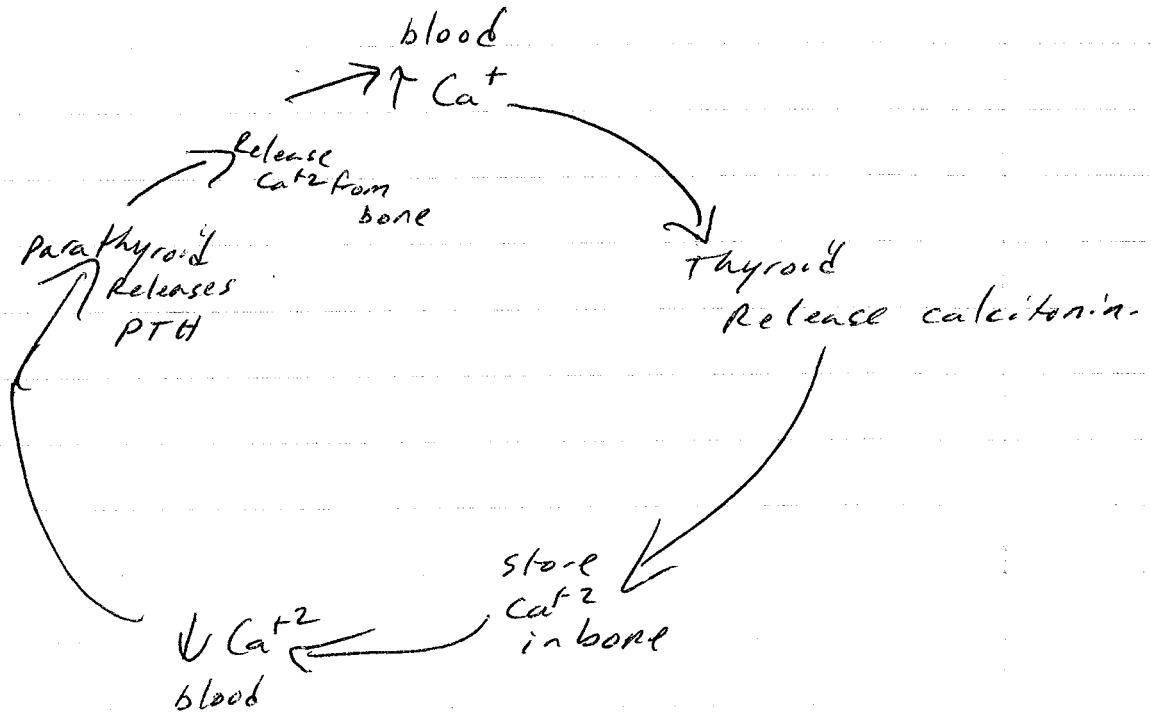
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(1)

⊕ feed =  $\Delta$  in variable amplifies  $\Delta$  ex. ADH from hypothalamus released when salt  $\uparrow$  ADH  $\uparrow$  permeability kidney  $\downarrow$  salt  $\downarrow$  ADH  
⊖ feed =  $\Delta$  in variable triggers response to counteract  $\Delta$  fluctuation  
T cell releases IL-2 which stim. proliferation of T cells

## Reg. of $Ca^{2+}$ in Blood

- ①  $\uparrow Ca^{2+}$  makes Thyroid secrete calcitonin ⊖ feed
- ② calcitonin  $\downarrow Ca^{2+}$  by  $\uparrow$  bone deposition +  $\downarrow Ca^{2+}$  uptake in intestines
- ③ as  $Ca^{2+}$  levels drop PTH (parathyroid hormone) ⊖ feed released from PT glands in thyroid
- ④ PTH  $\uparrow$  uptake from intestines +  $Ca^{2+}$  release from bones  $\uparrow Ca^{2+}$  in blood
- ⑤ Process Repeats

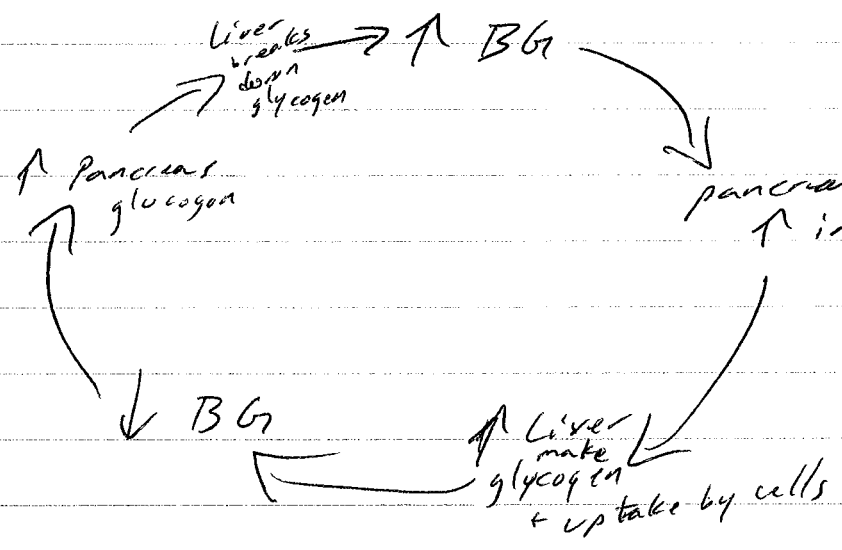


# Reg of Glucose in Blood

- ① ↑ in blood Glucose = pancreas ↑ insulin ⊖
- ② ↑ insulin causes Liver to convert glucose to glycogen ↓ Blood glucose + uptake <sup>glucose</sup> into cells
- ③ ↓ in Glucose = pancreas ↑ glucagon ⊕
- ④ ↑ glucagon causes Liver to convert glycogen to sugar
- ⑤ ↑ in BG repeats

\* Islets of Langerhans has alpha cells = glucagon  
Beta cells = insulin

\* Insulin inhibits breakdown of glycogen + conversion of AA's + fats into sugar



Ovarian Cycle

- 1) Release of GnRH from hypothalamus
- 2) Stim ante pit. release of FSH + LH
- 3) Stim follicle dev.
- 4) follicle start to make estrogen
  - low levels inhibit pituitary secretion
  - keeps FSH + LH  $\downarrow$
- 6) as Estrogen  $\uparrow$ ,  $\uparrow$  ES levels ~~at the~~ <sup>stim</sup> ~~the~~ hypothalamus  $\uparrow$  GnRH  $\therefore$   $\uparrow$  LH
- 7)  $\uparrow$  LH = Release of egg
- 8) follicle turns into corpus luteum secreting progesterone + estrogen =  $\ominus$  feed on hypothal  $\therefore$   $\downarrow$  LH + FSH
  - progesterone maintains uterus
  - estrogen  $\uparrow$  uterus

p. 1023/4

## Fertilization

- 1) Contact - sperm acrosome releases enzymes
- 2) Enzymes digest jelly coat - proteins from sperm bind to receptors on egg memb.
- 3) Contact + fusion of sperm + egg memb.
  - triggers depolarization of memb.
  - "fast block"
  - ion channels open in memb. -  $\text{Na}^+$  ions flow into egg +  $\Delta$  mem. potential  $\approx$  1-3 seconds
- 4) Cortical Rx - cortical granules in egg fuse w/ plasma memb. creating fertilization envelope
  - "slow block"
  - sperm activates pathways releasing  $\text{Ca}^{+2}$  into cytosol -  $\text{Ca}^{+2}$  cause fusion of granules to membrane



# Protein + Steroid Hormone function CH 15

## I. Steroids

- non-polar lipids
- ① - pass through cell mem & bind w/ receptor
  - this complex passes through Nuc. mem. & act as transcription factors (promotes or inhibits RNA poly)
- ② Type II receptors located in nucleus

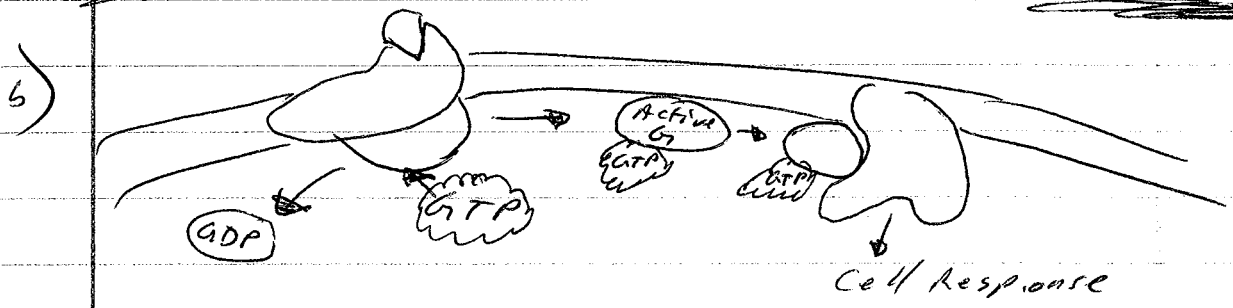
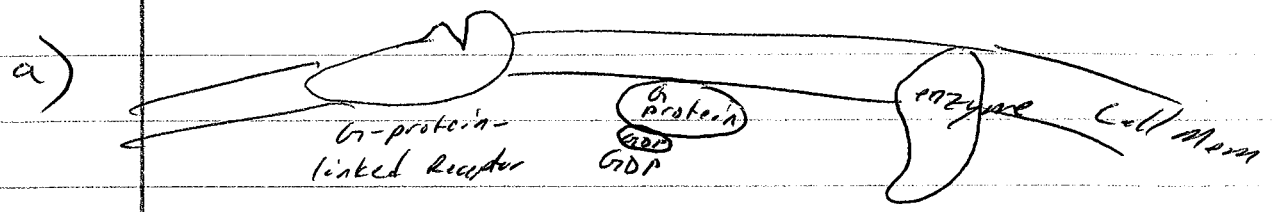
## II. Proteins

CH 11

- typically act as 2<sup>nd</sup> messenger systems
- 3 steps: Reception, transduction, Response

### A. Reception

Hormone acts as signal molecule (ligand) binding to cell membrane protein (G protein) acts as on/off switch for pathway



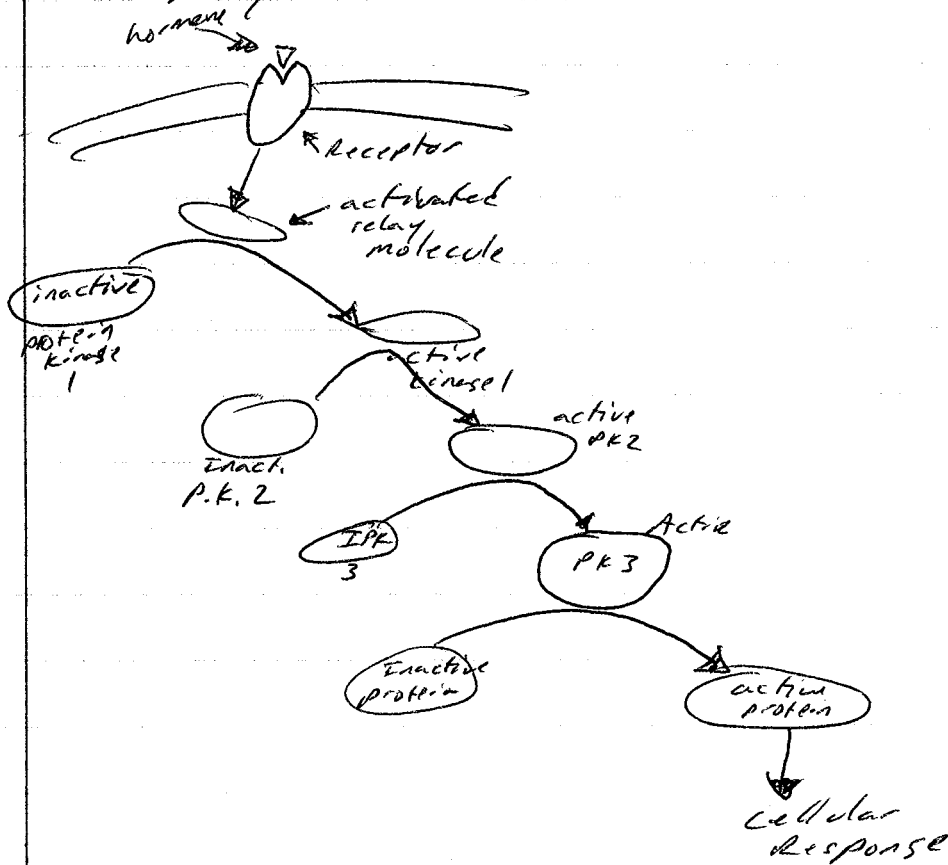
### B. Transduction

- conversion of signal to a form that can bring about a specific cell response
- often multi-step which benefits amplification
  - if some molecules transmit the signal to multiple molecules of next step a larger cell response occurs

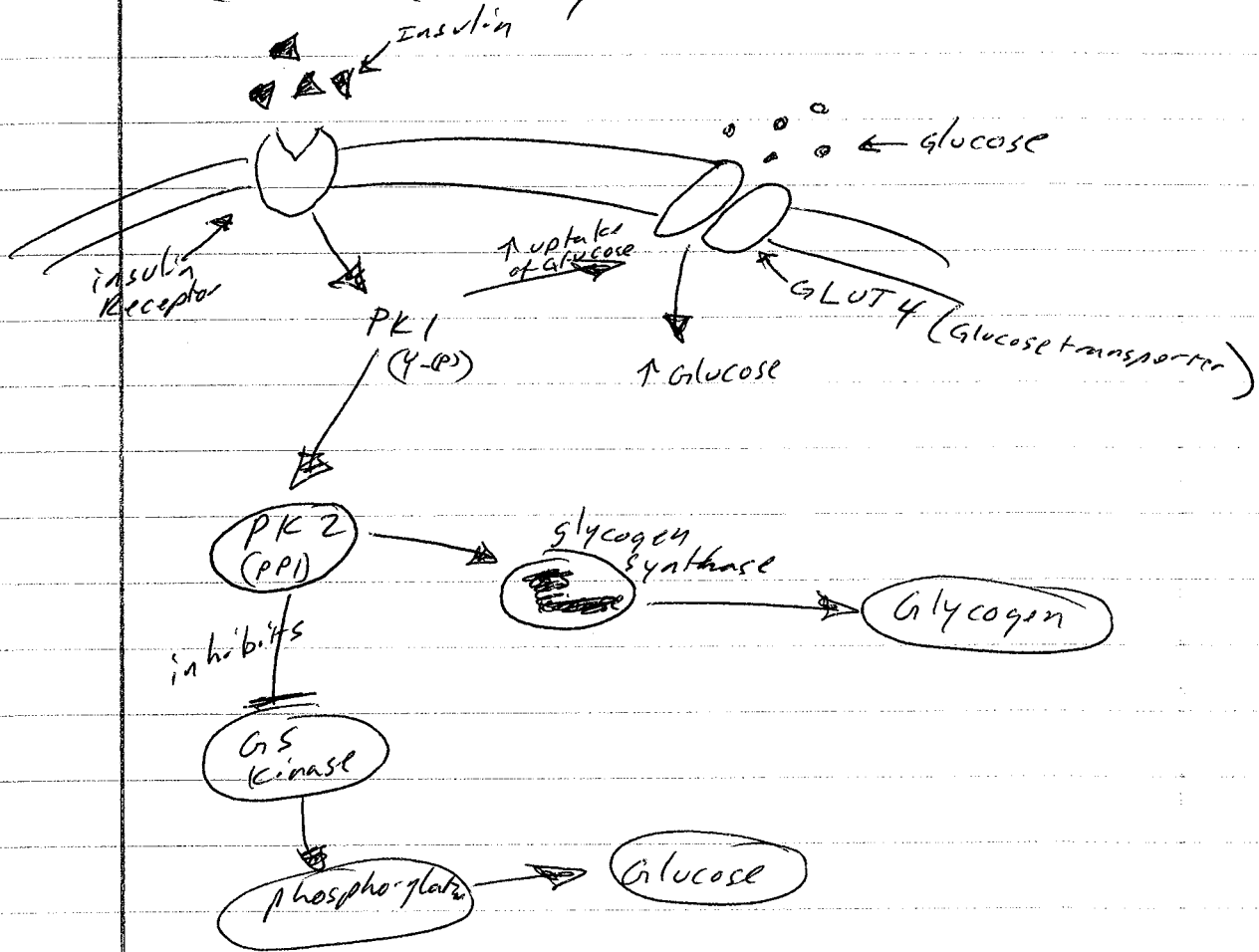
### C. Response

- catalysis by enzymes, rearrangement of cytoskel...

### D. Phosphorylation Cascade



### E. Insulin activity



- also causes ↑ glycolysis, production of fatty acids

tropic hormones regulate function of endocrine cells/glands  
 IGF - insulin-like growth factor

Glands and hormones	Target Tissues	Action	hypersecretion	hyposecretion
<b>Anterior Pituitary</b>				
adrenocorticotrophic hormone (ACTH)		stim adrenal to make glucocorticoids		
growth hormone (GH)	Liver → IGF-1	stim growth + metabolism	gigantism ↑ height	↓ growth
thyroid stimulating hormone (TSH)	thyroid	stim thyroid		
prolactin	mammary gland	stim milk production		
follicle stimulating hormone (FSH)		stim gonads		
lutinizing hormone (LH)		stim ovary + testes		
<b>Posterior Pituitary</b>				
oxytocin		milk prod		
antidiuretic hormone (ADH)		stimulates uterine contraction		
		Promotes H <sub>2</sub> O retention in kidneys		
<b>Thyroid gland</b>				
thyroxine		stim metab.	↑ body temp weight loss	weight gain lethargy
calcitonin		↓ Blood Ca <sup>2+</sup> levels		
<b>Parathyroid</b>				
parathyroid hormone (PTH)	Bone + kidney	↑ Blood Ca <sup>2+</sup> level		
<b>Pancreas- Islets of Langerhans</b>				
glucagon	Liver	release of glucose		
insulin	<del>Liver</del> <del>β cells</del>	uptake of glucose	↓ Blood sugar coma	↑ sugar - Diabetes / gangrene
<b>Adrenal gland (medulla)</b>				
epinephrine and norepinephrine (adrenalin)		↑ glucose, vasoconstrict	suppress immune anti-inflam	
<b>Adrenal gland (cortex)</b>		↑ adrenal stress		
aldosterone	maintain salt + H <sub>2</sub> O balance			
cortisol	break down muscle, ↑ glucose			
<b>Ovaries (female only)</b>				
estrogen	skin lining growth + sex			
progesterone	skin lining growth			
<b>Testes (male only)</b>				
testosterone	support sperm prod + sex			