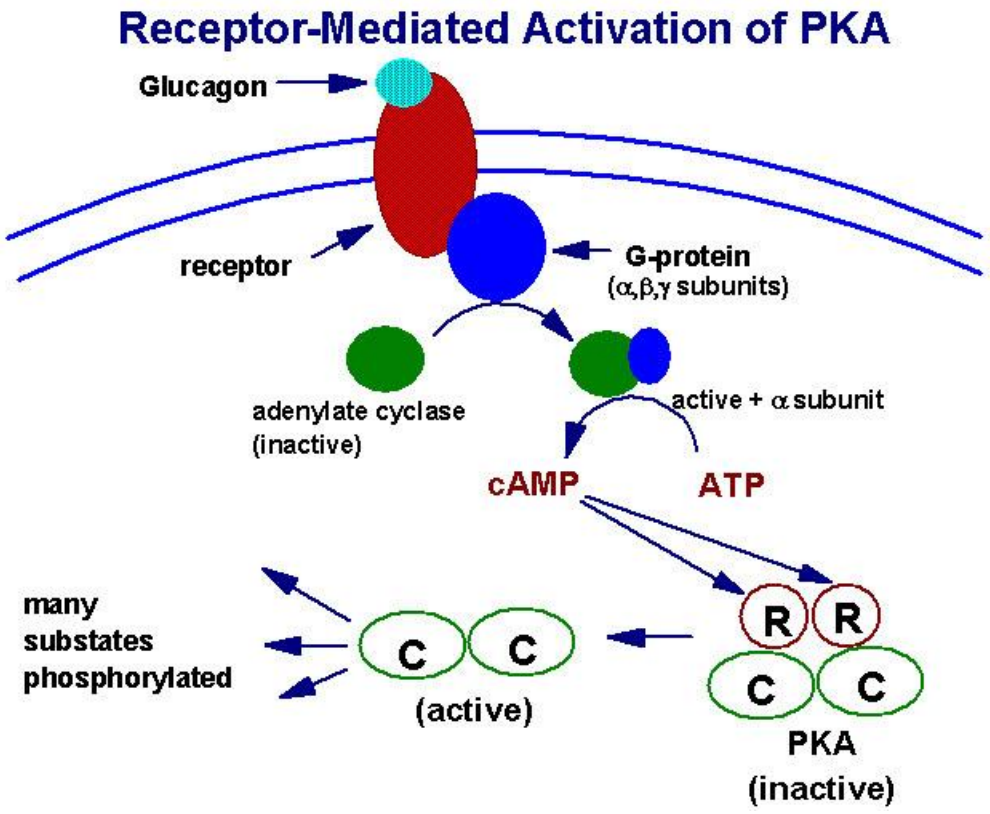
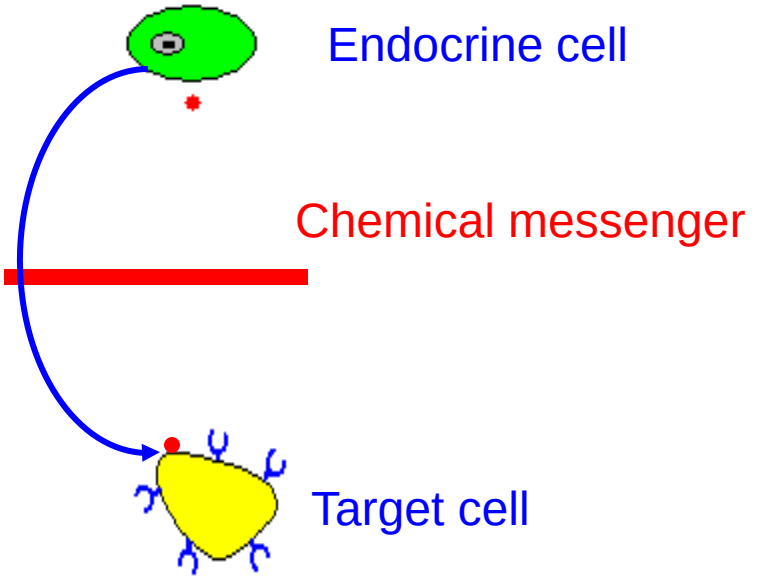
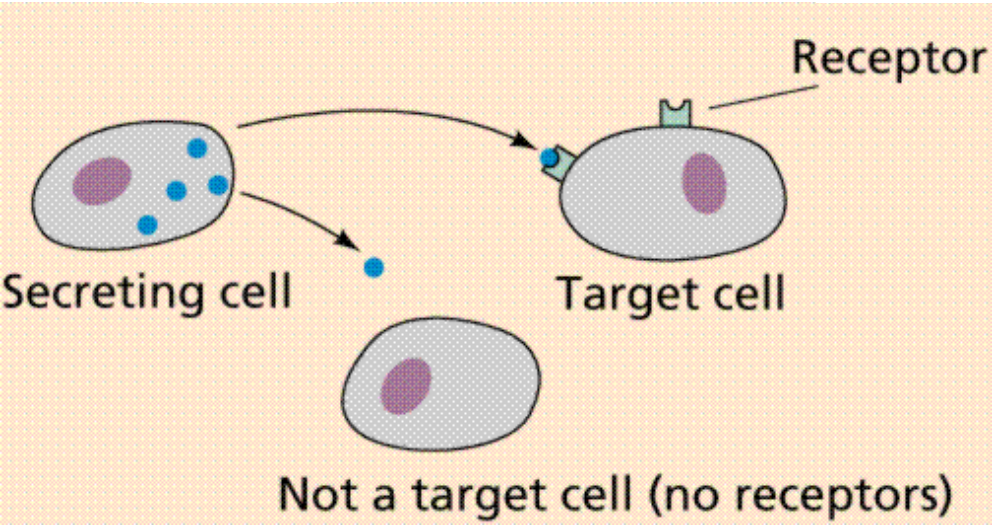
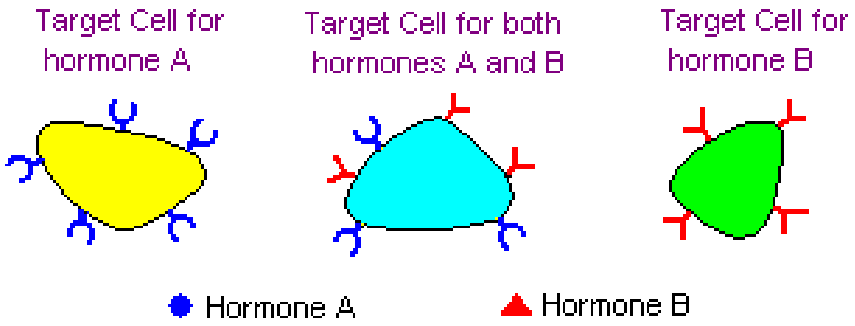
Endocrine Physiology



1. Introduction to Endocrine Principles



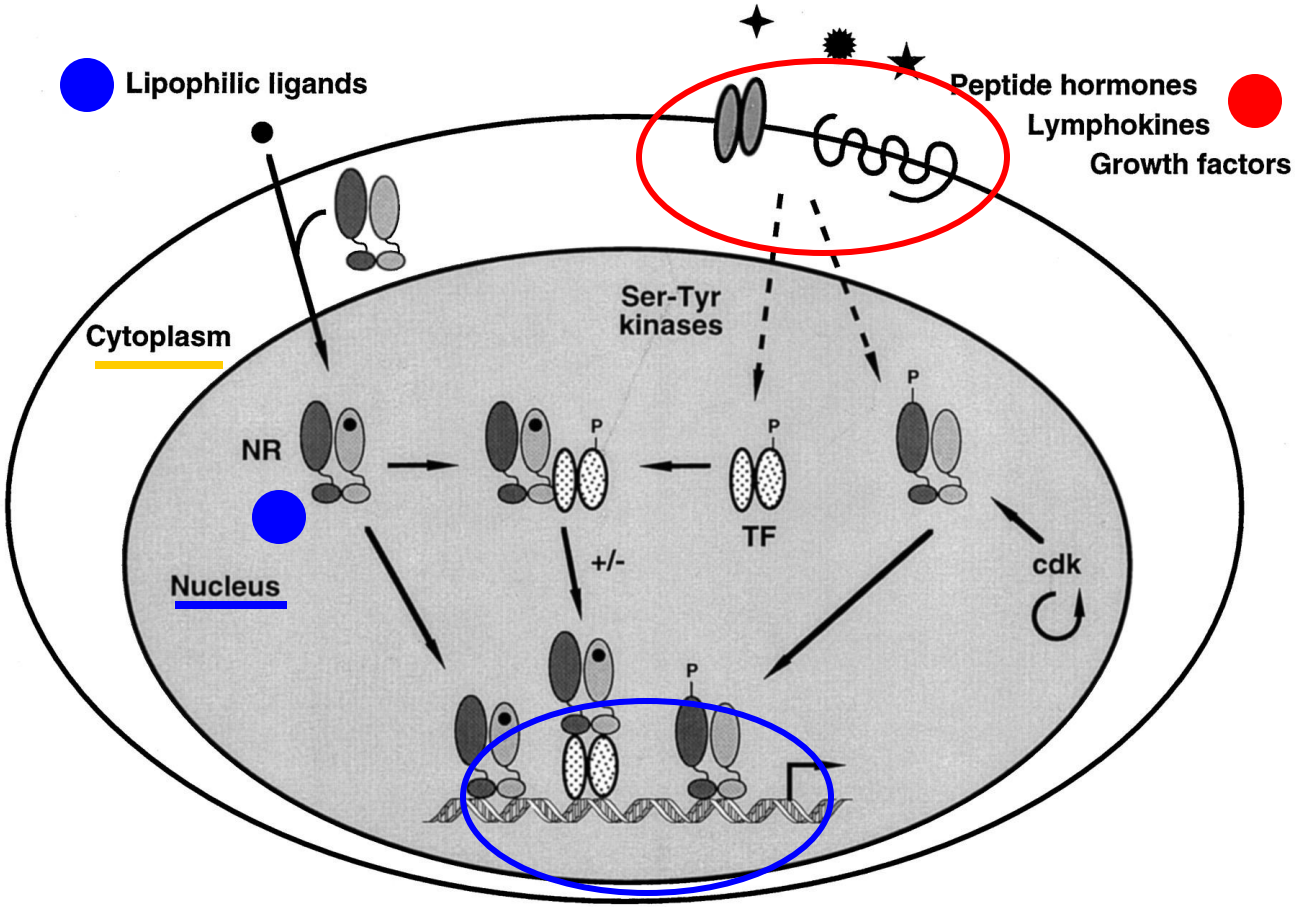




Hormones are Chemical messenger with a half life and a target cell

There are TWO major groups of hormones

Location of Receptor	Classes of Hormones	Principle Mechanism of Action
Cell surface receptors (plasma membrane)	Proteins and peptides, catecholamines and eicosanoids	Generation of ***second messengers*** which alter the activity of other molecules - usually enzymes - within the cell
Intracellular receptors (cytoplasm and/or nucleus)	Steroids and thyroid hormones	Alter **transcriptional activity** of responsive genes

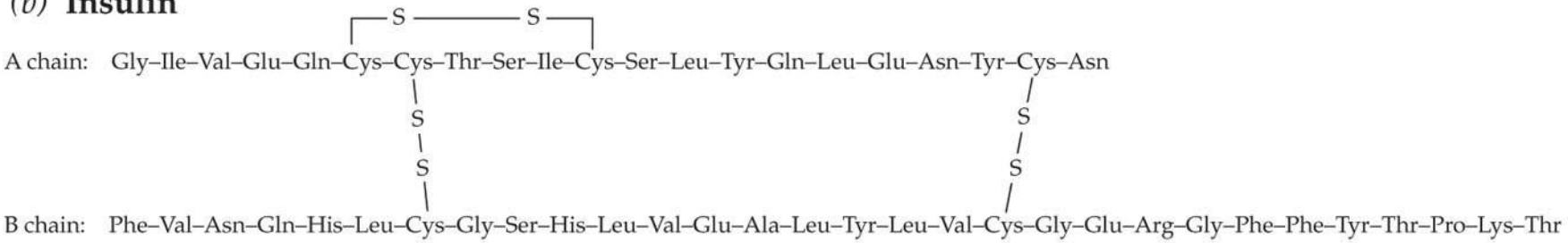


Peptide and protein hormones consist of assemblages of amino acids

(a) Gonadotropin-releasing hormone (GnRH)

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

(b) Insulin



Peptidic Hormones can be synthesized as larger pre-prohormones

- 197 AA pre-proprotein.
- 5 allatostatins (8-11 AA).

Aedes aegypti **Allatostatin "A"**

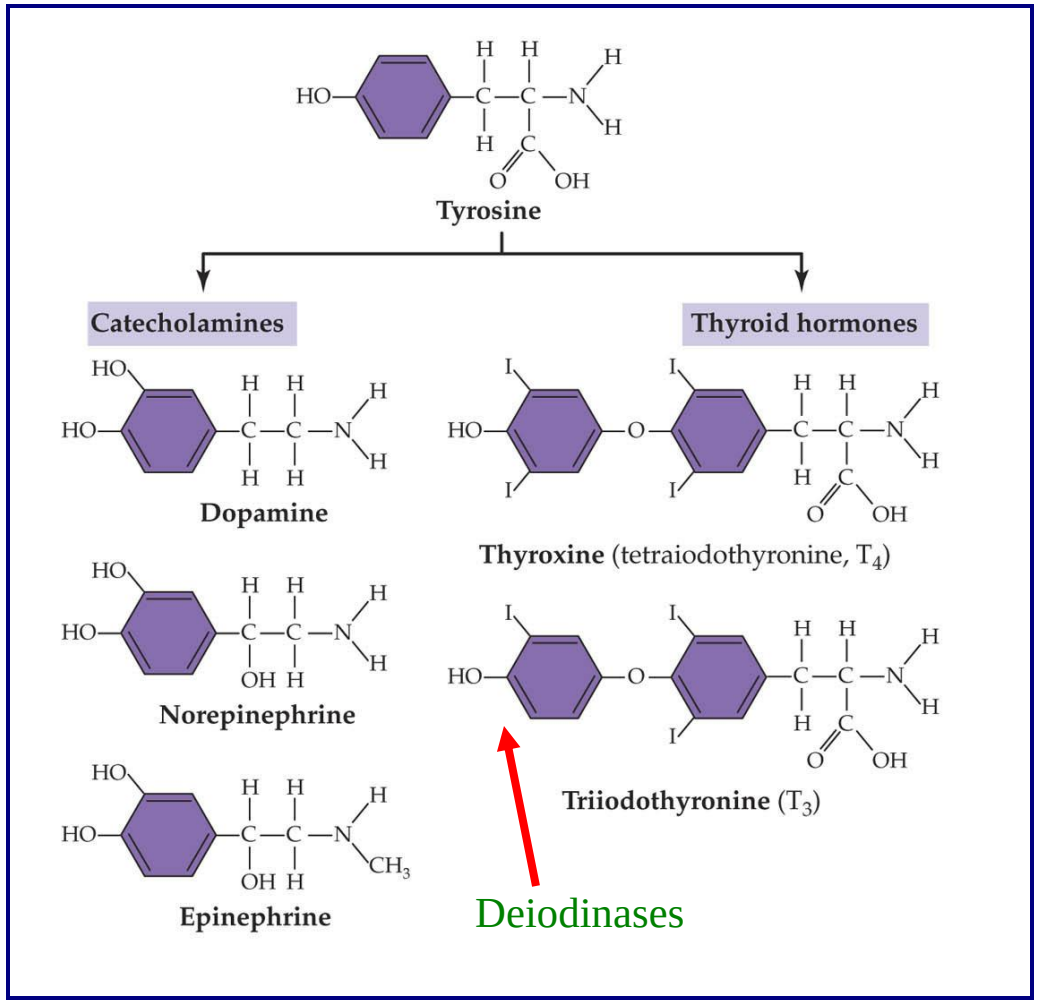
1 Mrpsttpmvllsylafvlclacvaygssalgsssgssdqslfgggaggggsasaesdig
61 ddrgqreisqatfqhmlavrspkynfglgkrryiiedvpgrlphynfglgkrarnnll
121 eydddsapswsedysslipr**d**gl**d**y**d**g**d**k**d**ksaekrasayryhfglgkrrvydfglgkrv
181 yedkrlpnrynfglgkr

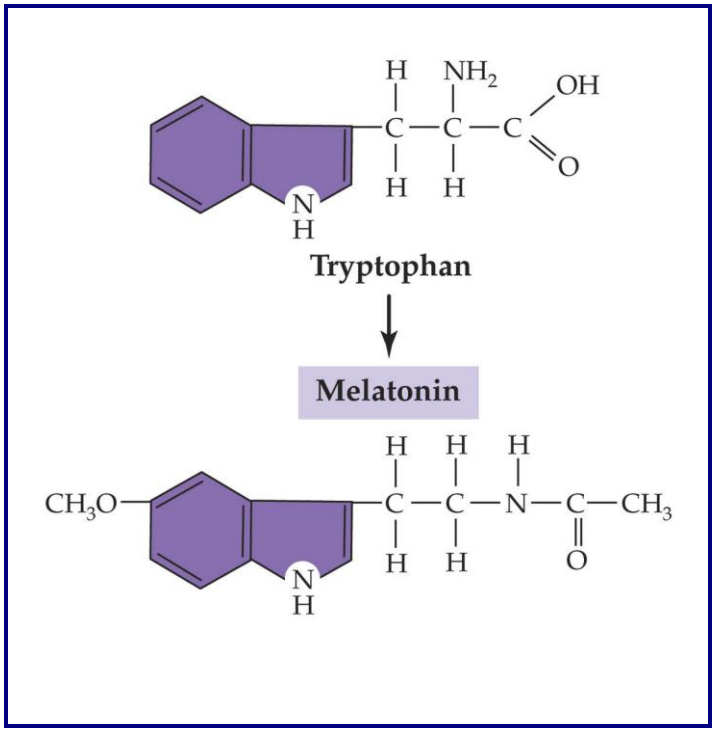
Anopheles gambiae

1 Mlalsayvtlslclsvswslpagggtagsssssndldmddlsrdrvsgqgeistsqfqh
61 mlavrspkynfglgkrryiiedvpgrlphynfglgkrgspmggn**d**y**e**y**d**glmggnqlg
121 wn**d**n**d**ytnlitk**d**gqf**d**y**d**a**e**k**e**kdaa**k**rtasgngrgsayryhfglgkraydfglgkry
181 fdaedfnkrlpnrynfglgkr

SPKYNFGLG	*Aedes*	1	RVYDFGLG	*Aedes*	4
SPKYNFGLG	*Anopheles*	1	RAYDFGLG	*Anopheles*	4
LPHYNFGLG	*Aedes*	2			
LPHYNFGLG	*Anopheles*	2	LPNRYNFGLG	*Aedes*	5
ASAYRYHFGLG	*Aedes*	3	LPNRYNFGLG	*Anopheles*	5
GSAYRYHFGLG	*Anopheles*	3			

Amine hormones are derived from amino acids

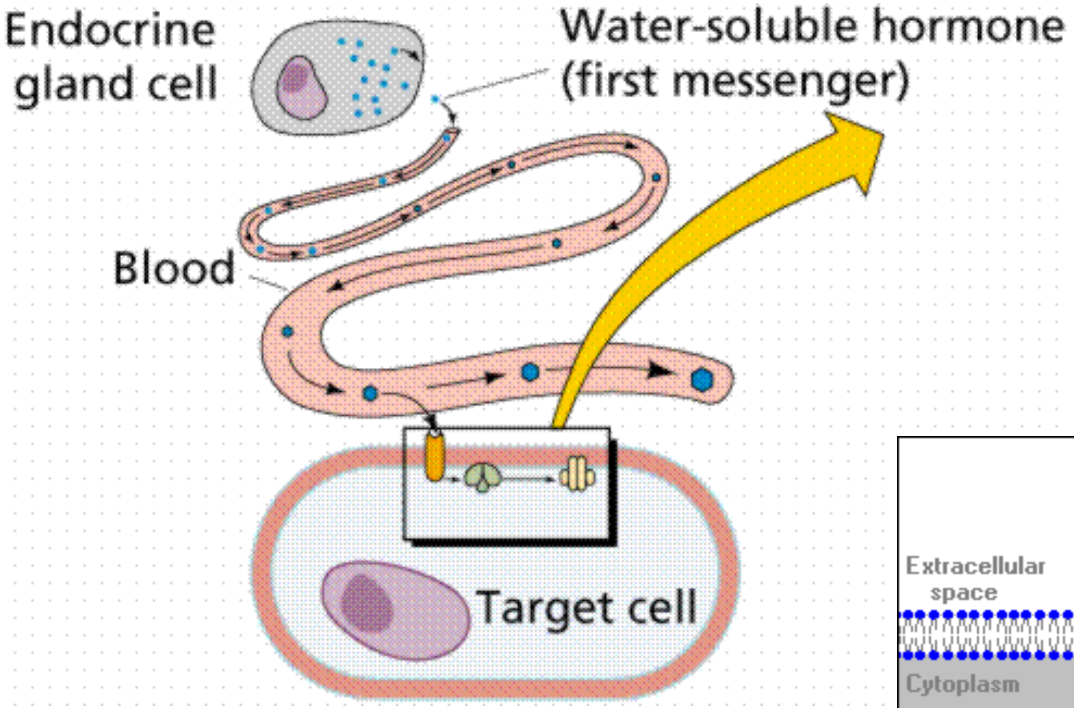


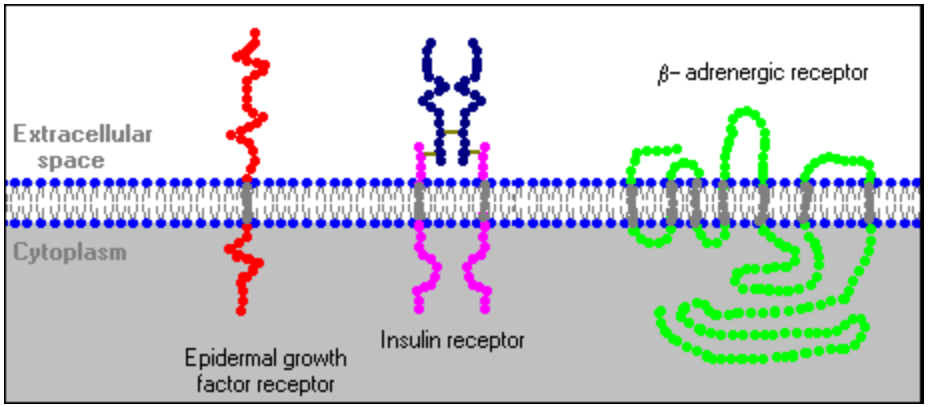


Peripheral activation

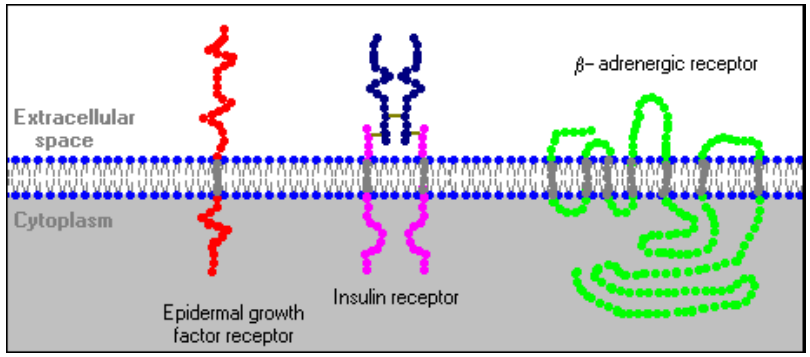
Peptide and protein hormones act through cell membrane receptors

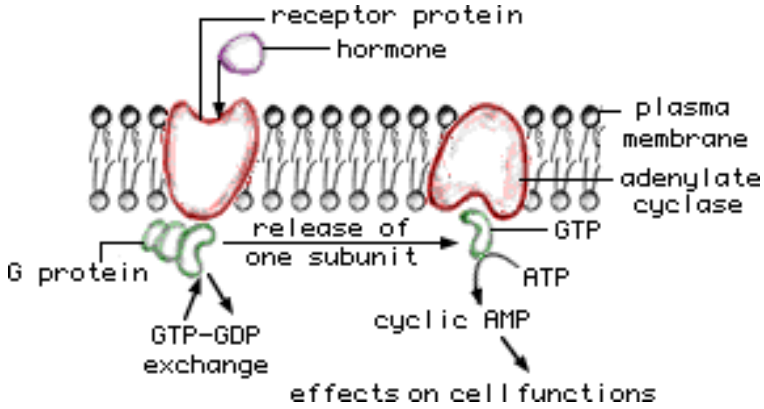
Location of Receptor	Classes of Hormones	Principle Mechanism of Action
Cell surface receptors (plasma membrane)	Proteins and peptides, catecholamines and eicosanoids	Generation of ***second messengers*** which alter the activity of other molecules - usually enzymes - within the cell

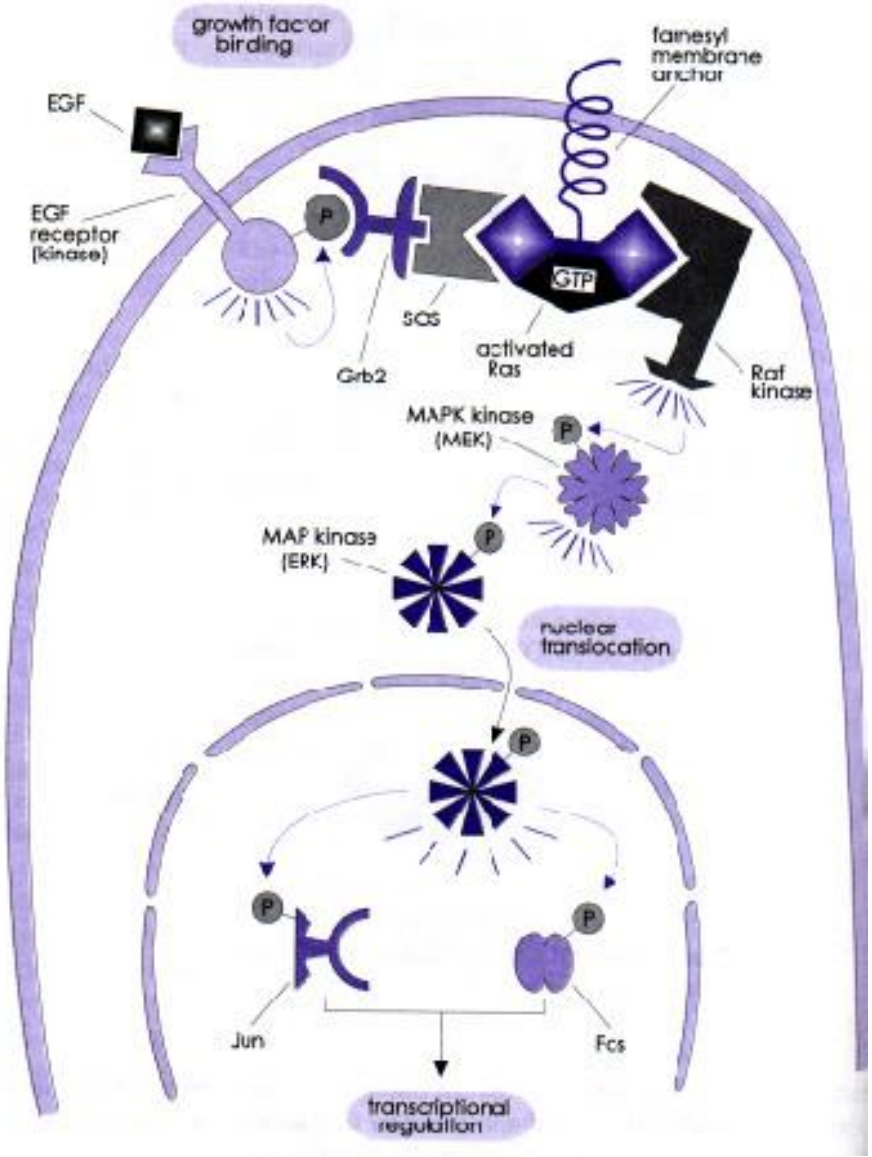




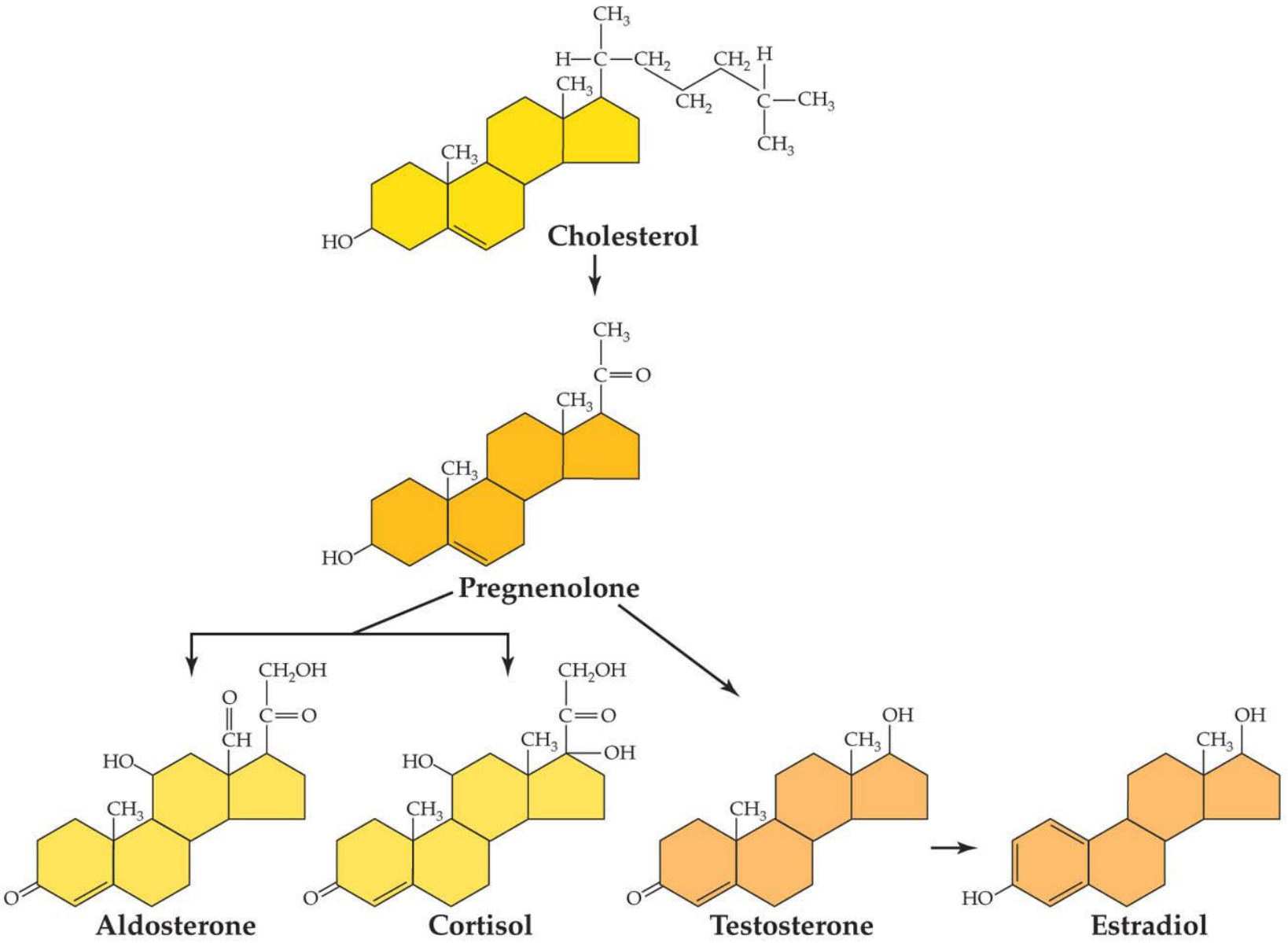
Peptide and protein hormones act through generation of **second messengers**





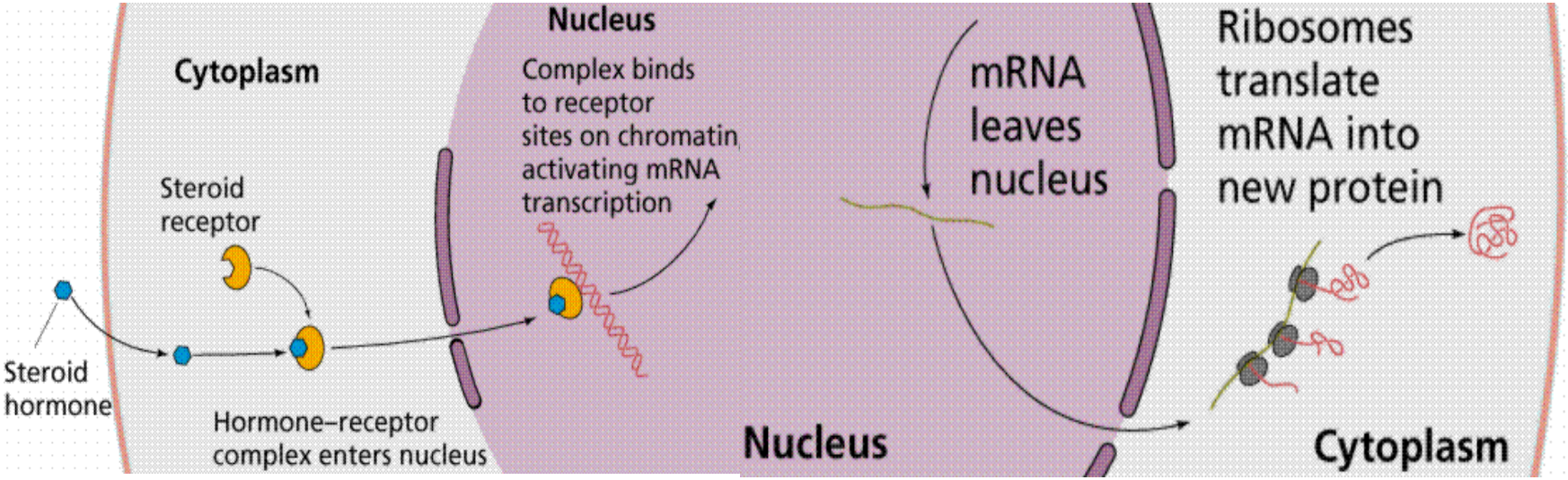


Steroid hormones are derived from cholesterol



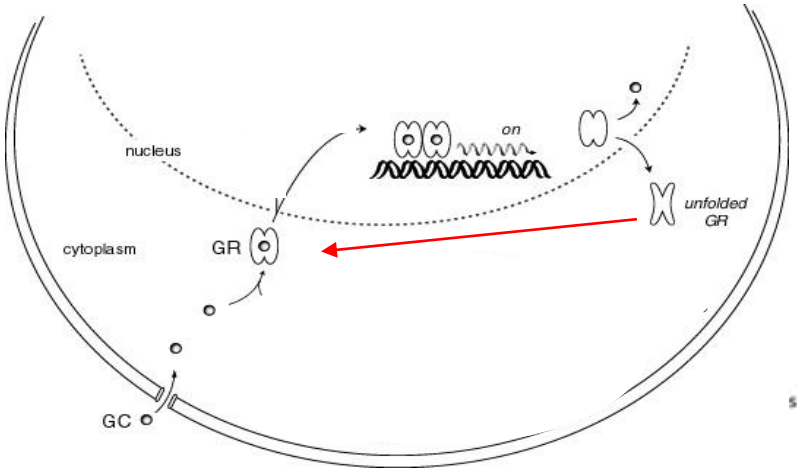
Lypophyllic hormones

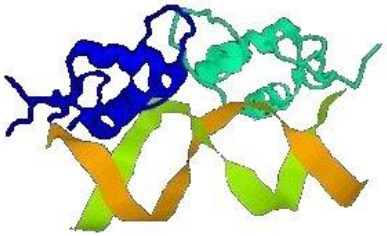
Location of Receptor	Classes of Hormones	Principle Mechanism of Action
Intracellular receptors (cytoplasm and/or nucleus)	Steroids and thyroid hormones	Alter **transcriptional activity** of responsive genes

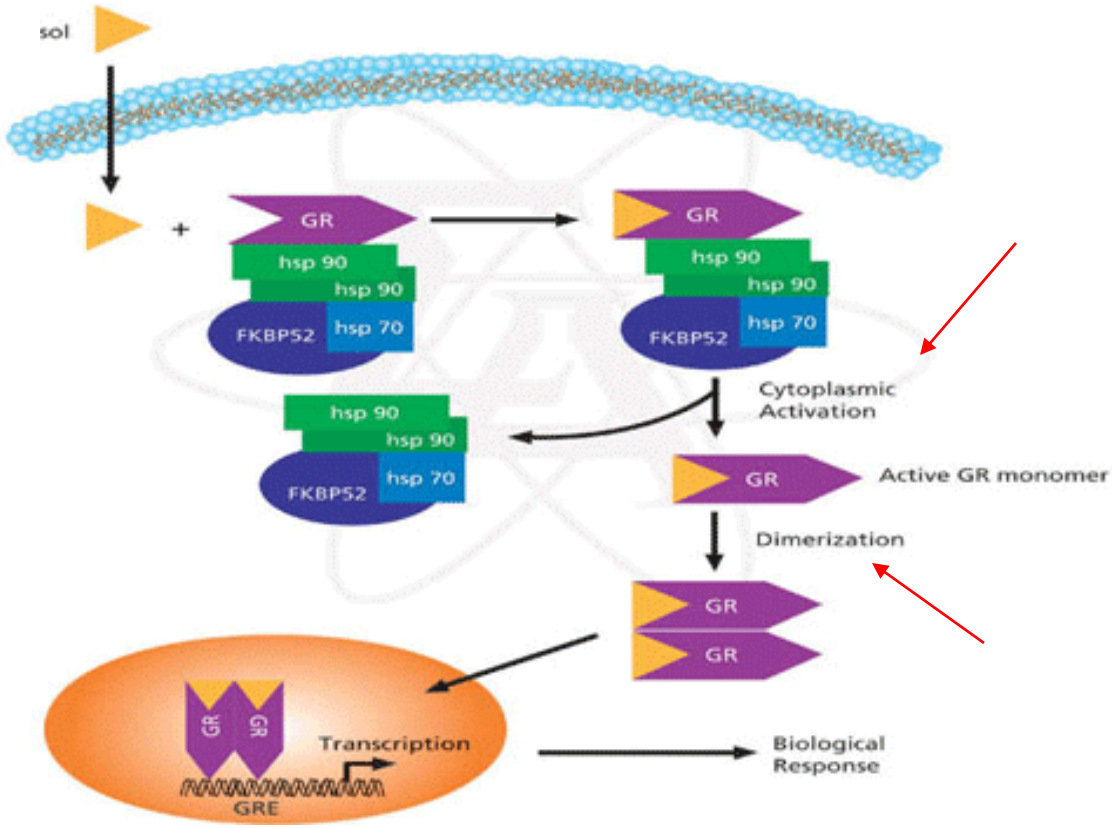


Delay of response

Mechanism of action of Steroid hormones

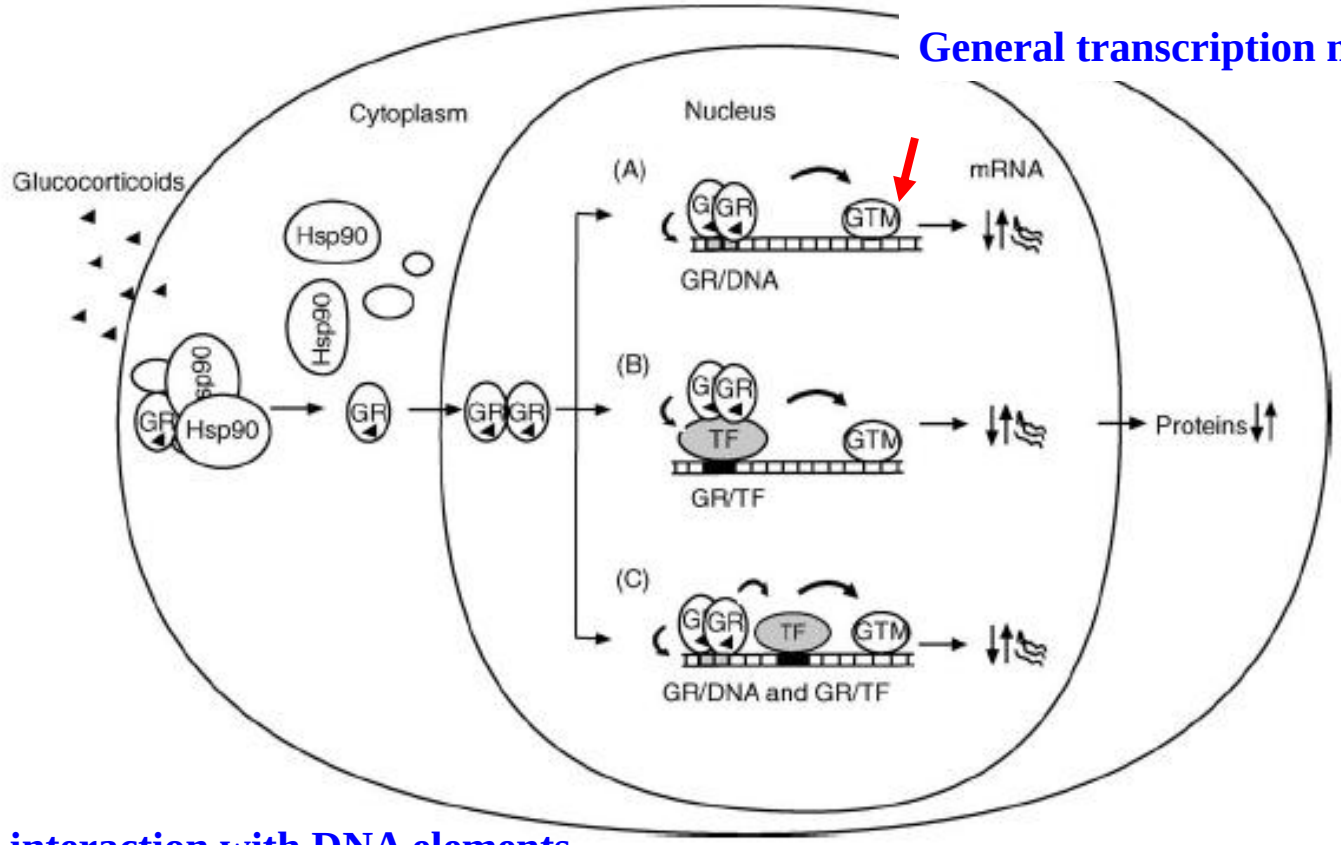




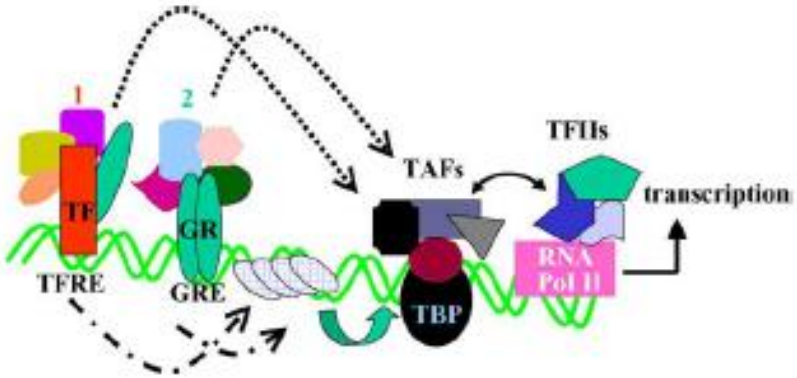


Activation of transcription

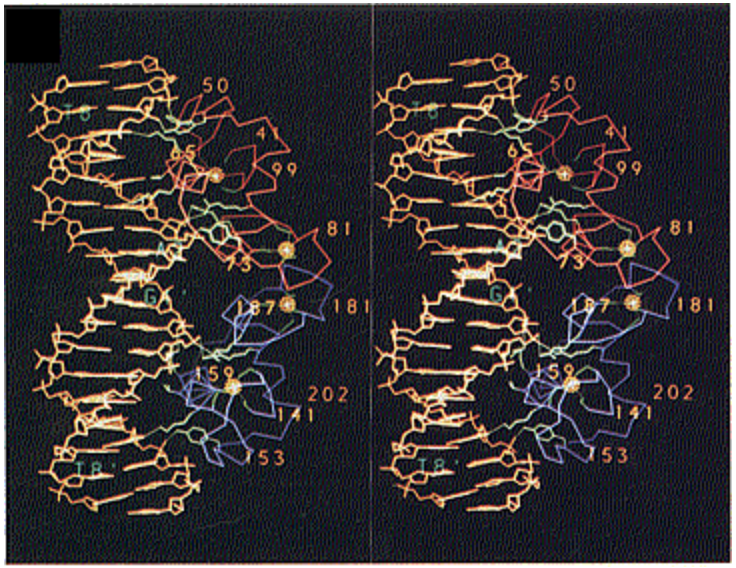
General transcription machinery

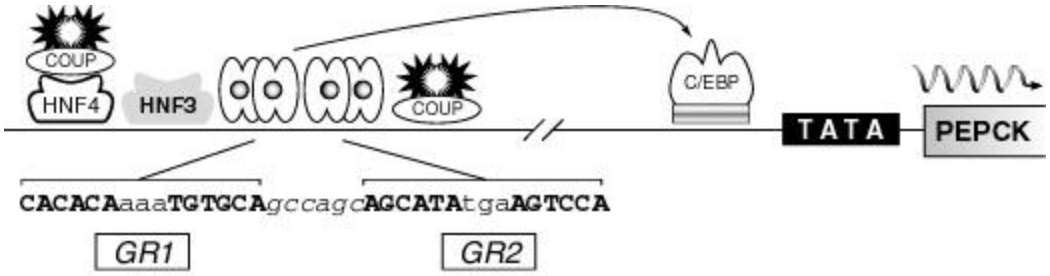


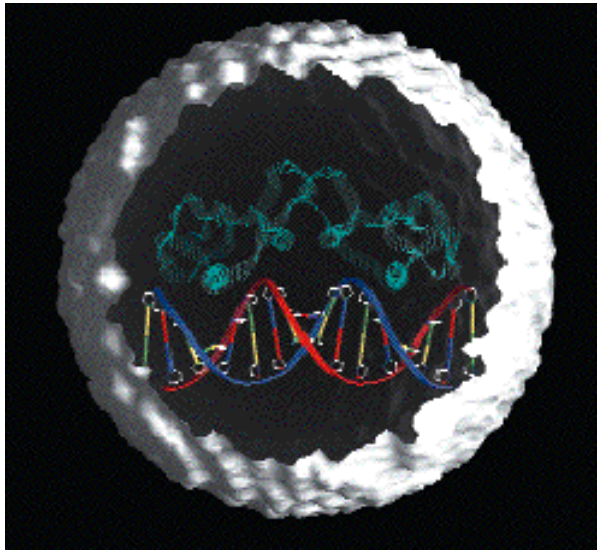
1. **Direct interaction with DNA elements**
2. **Cross-talk with another DNA-bound transcription factors**
3. **Interaction with both DNA elements and others TFs**

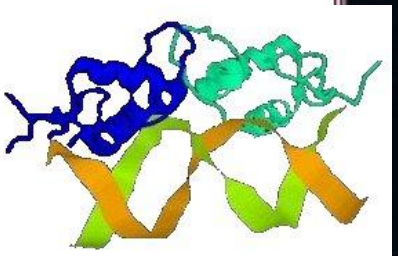


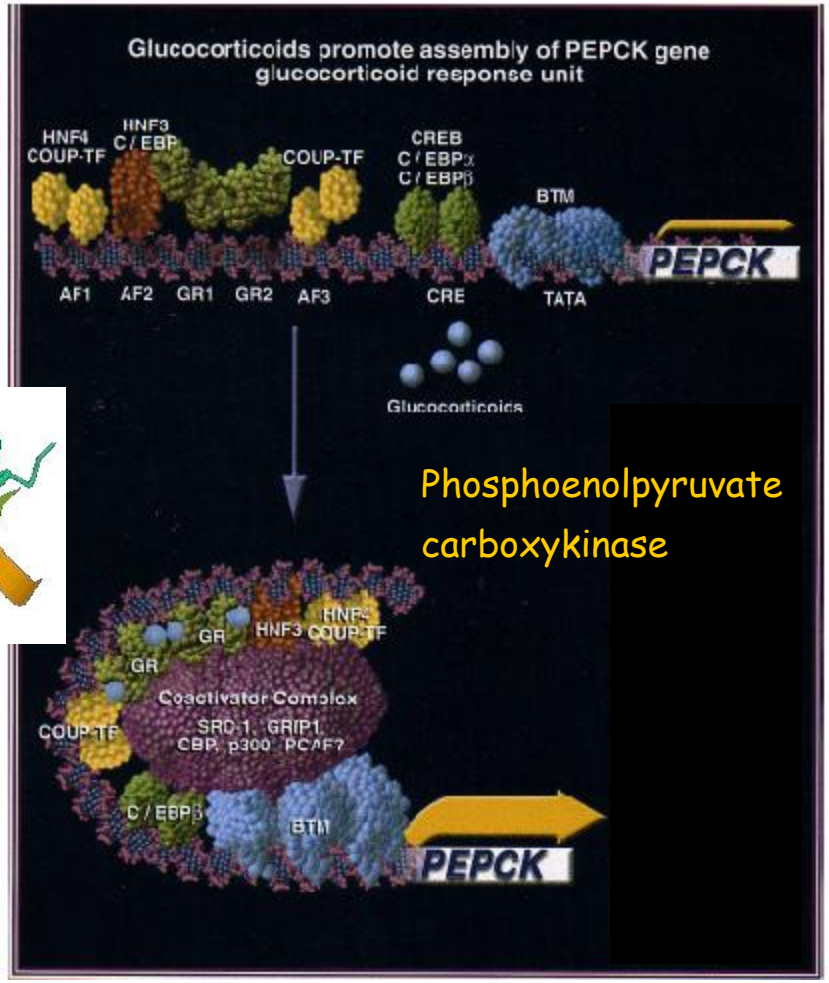
Lypophyllic hormones







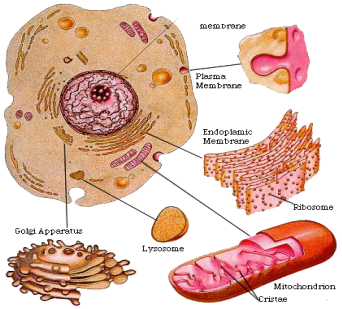


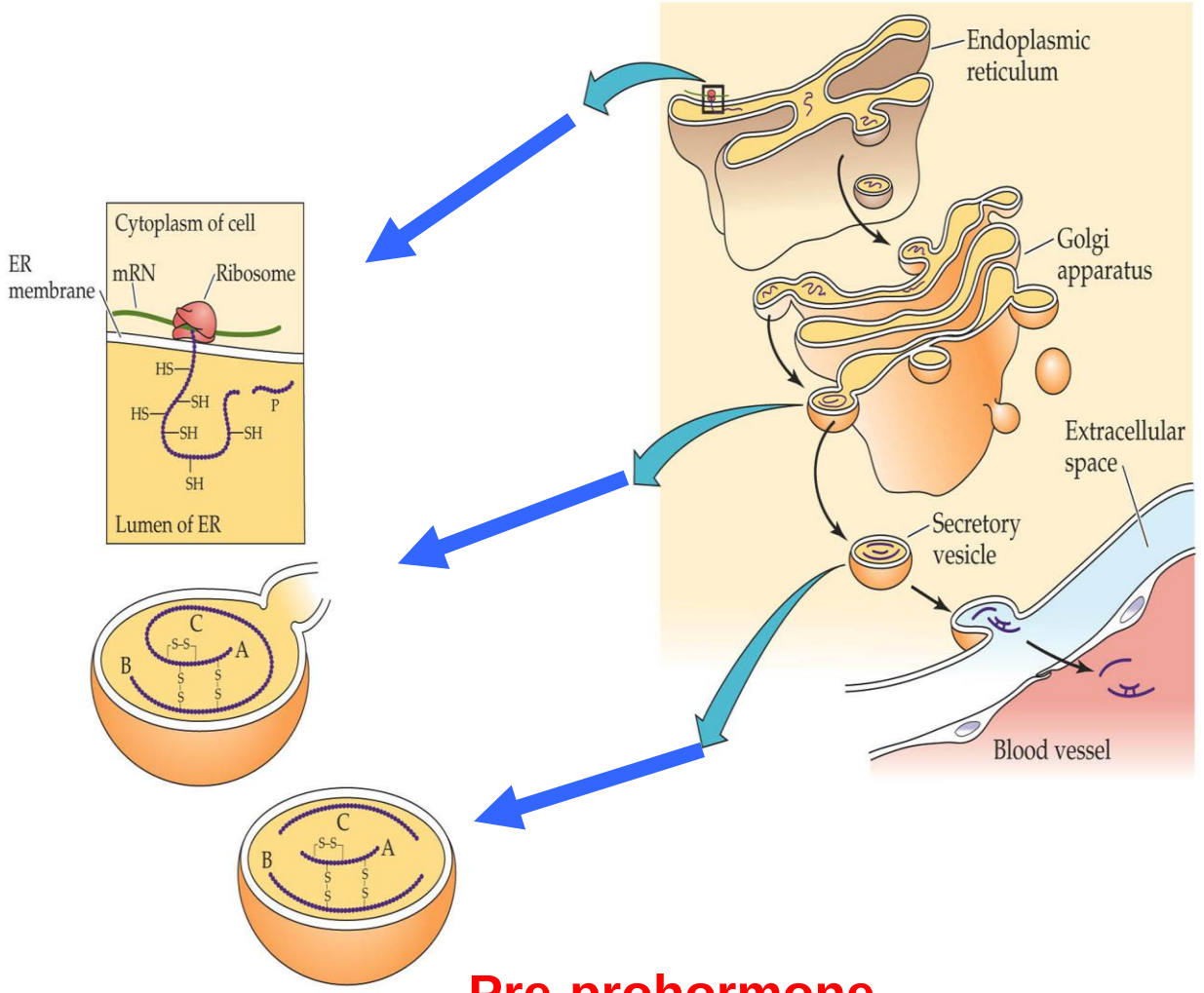


Phosphoenolpyruvate carboxykinase

2. Synthesis, Storage, and Release of Hormones

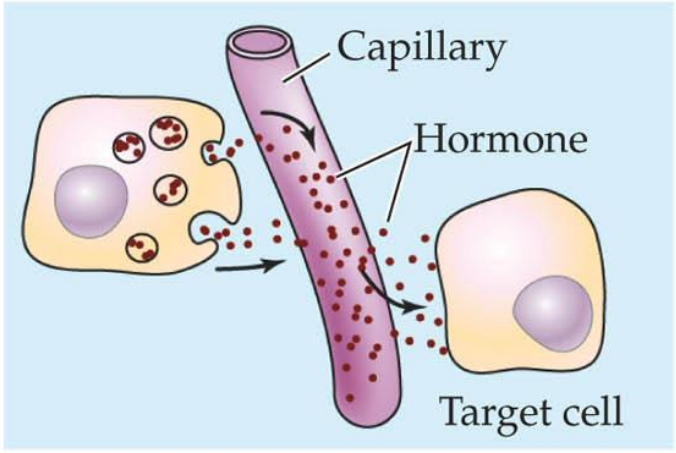
Snapshots of insulin synthesis, processing, and packaging



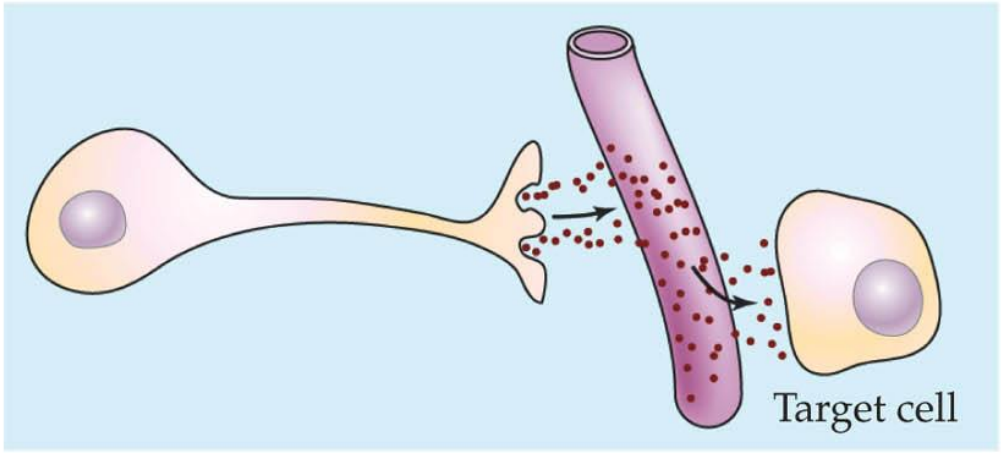


3. Types of Endocrine glands and cells

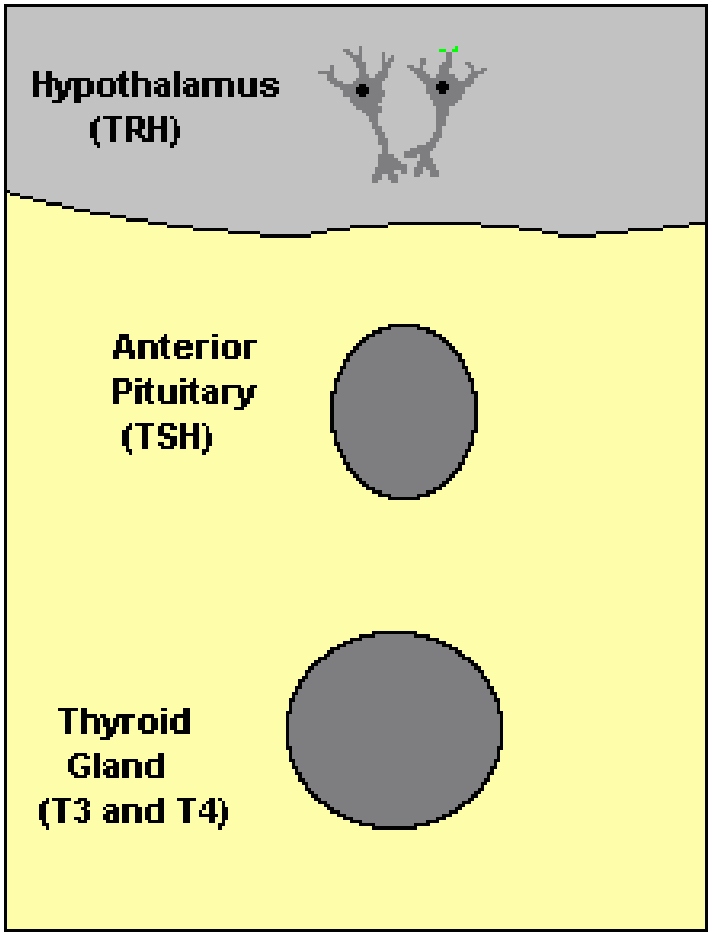
(a) Nonneural endocrine cell

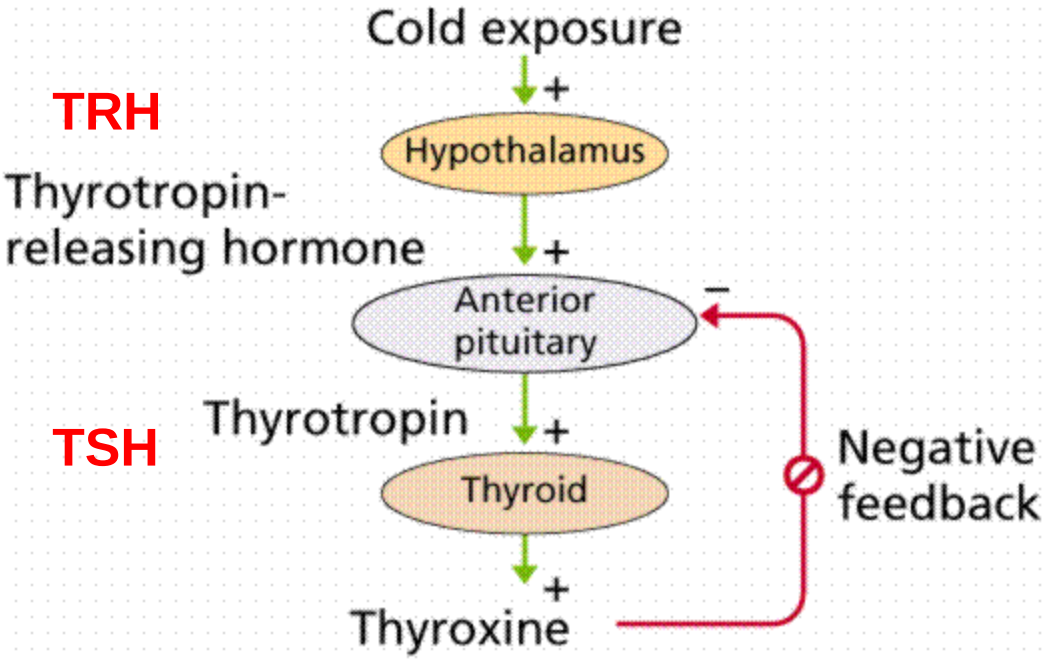


(b) Neurosecretory cell



4. Control of Endocrine Systems





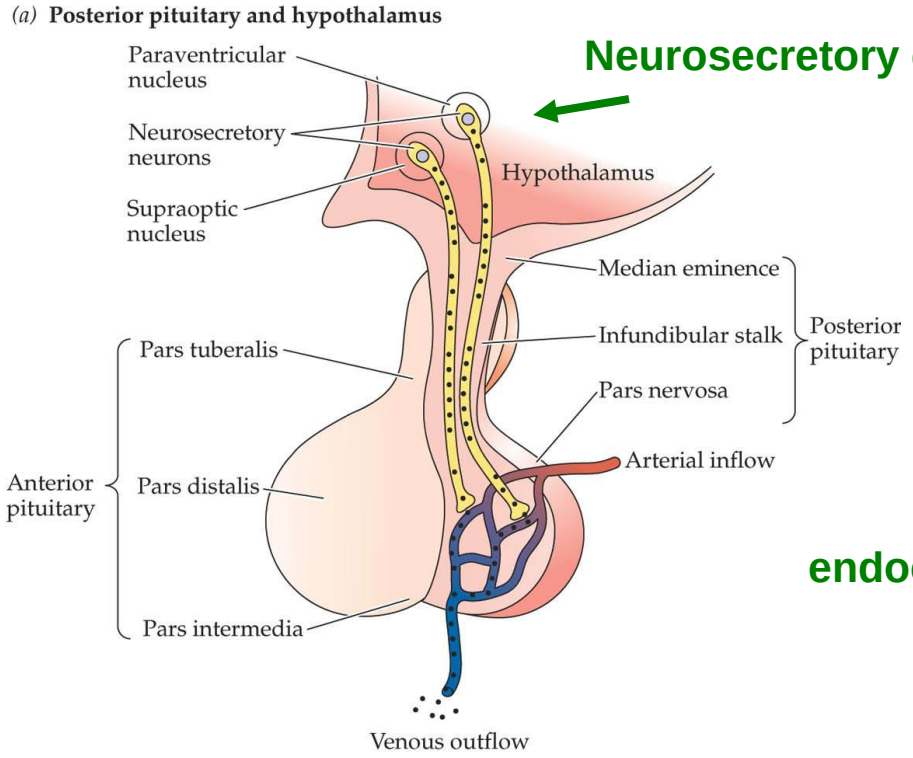
AXIS: One endocrine gland acting on another endocrine gland

The vertebrate pituitary gland

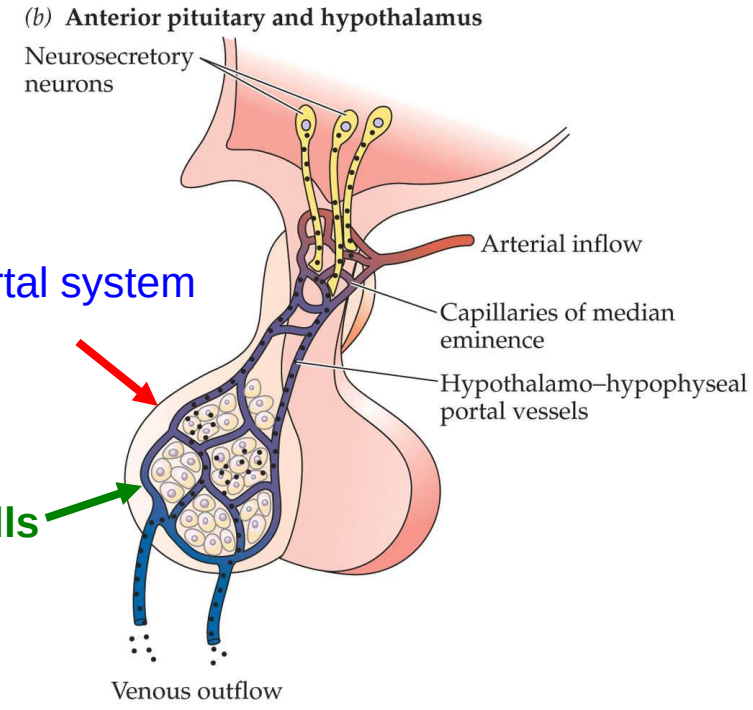
AXIS: One endocrine gland acting on another endocrine gland

Neurohypophysis.

Adenohypophysis.



Neurosecretory cells



Portal system

endocrine cells

Neural control of neurosecretory cells

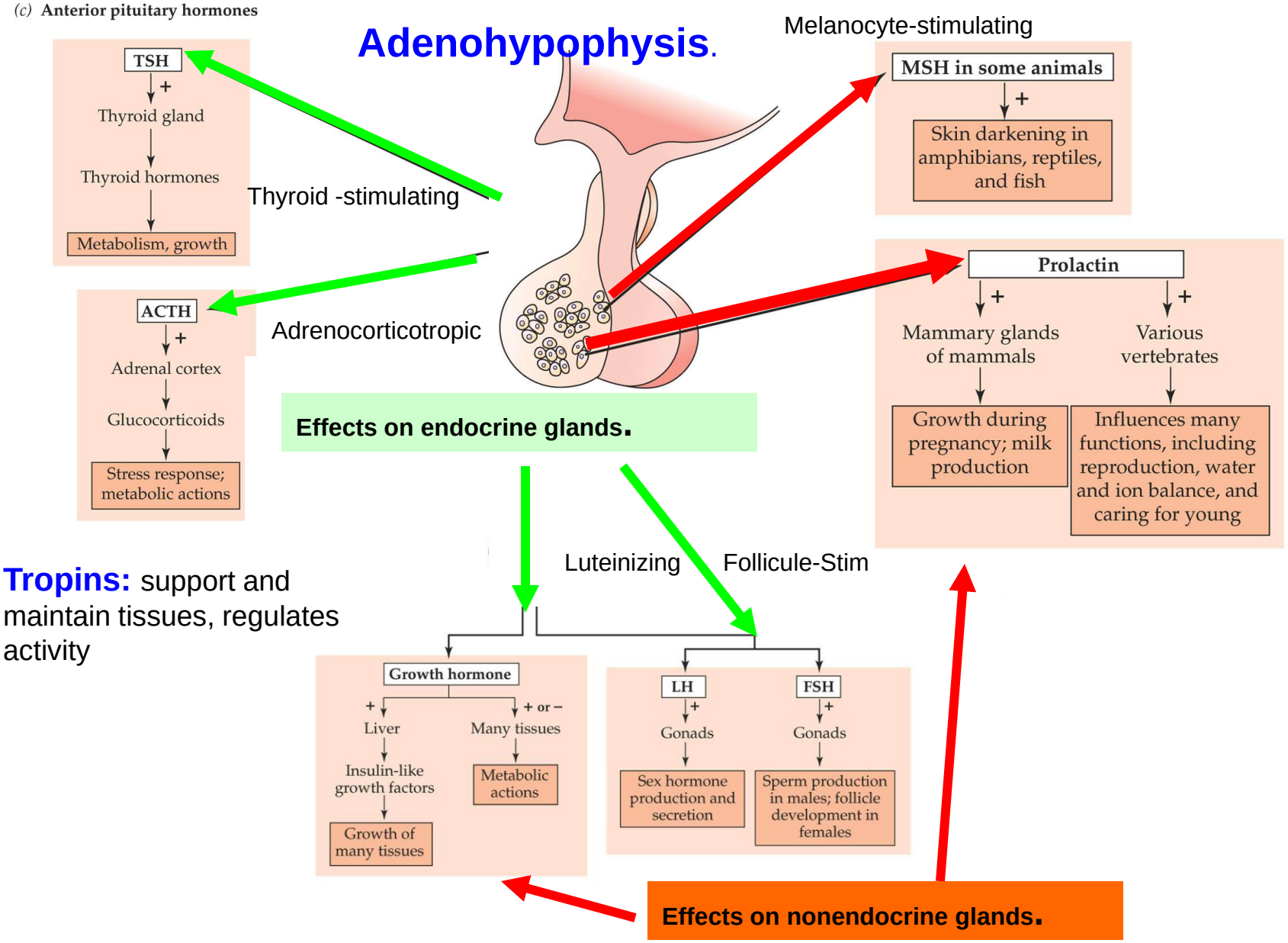
Action potential --- release hormones

Neurosecretory control of endocrine cells

Release factors --- synthesize hormones.

The vertebrate pituitary gland

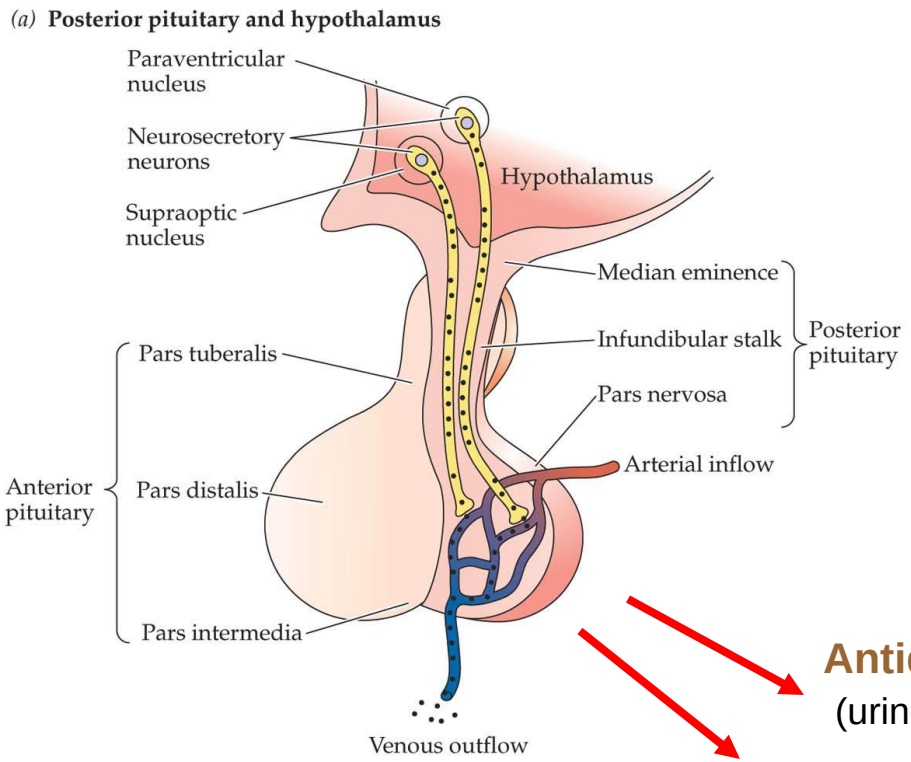
synthesize hormones.

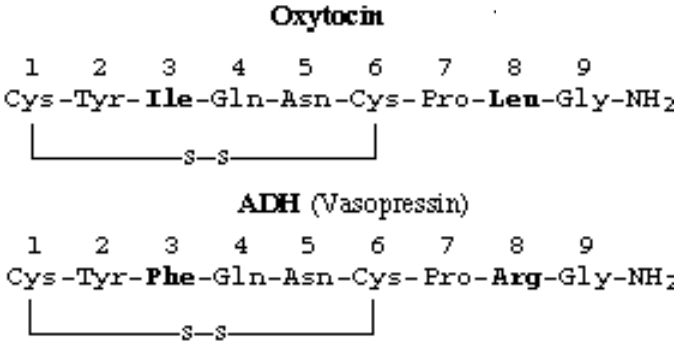


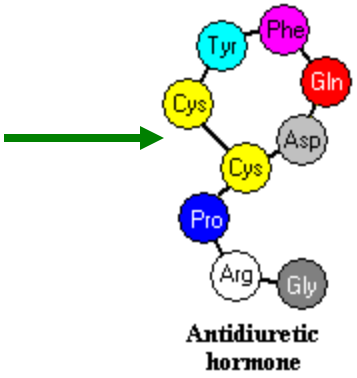
Tropins: support and maintain tissues, regulates activity

The vertebrate pituitary gland

Neurohypophysis. release hormones





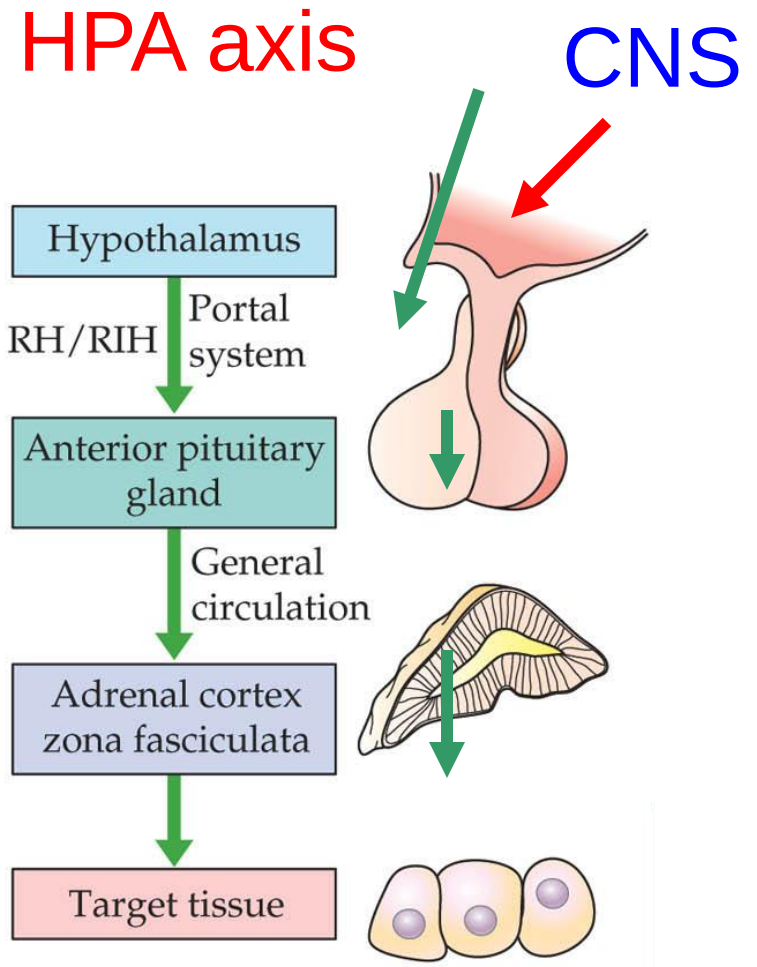


Antidiuretic hormone (urine production)

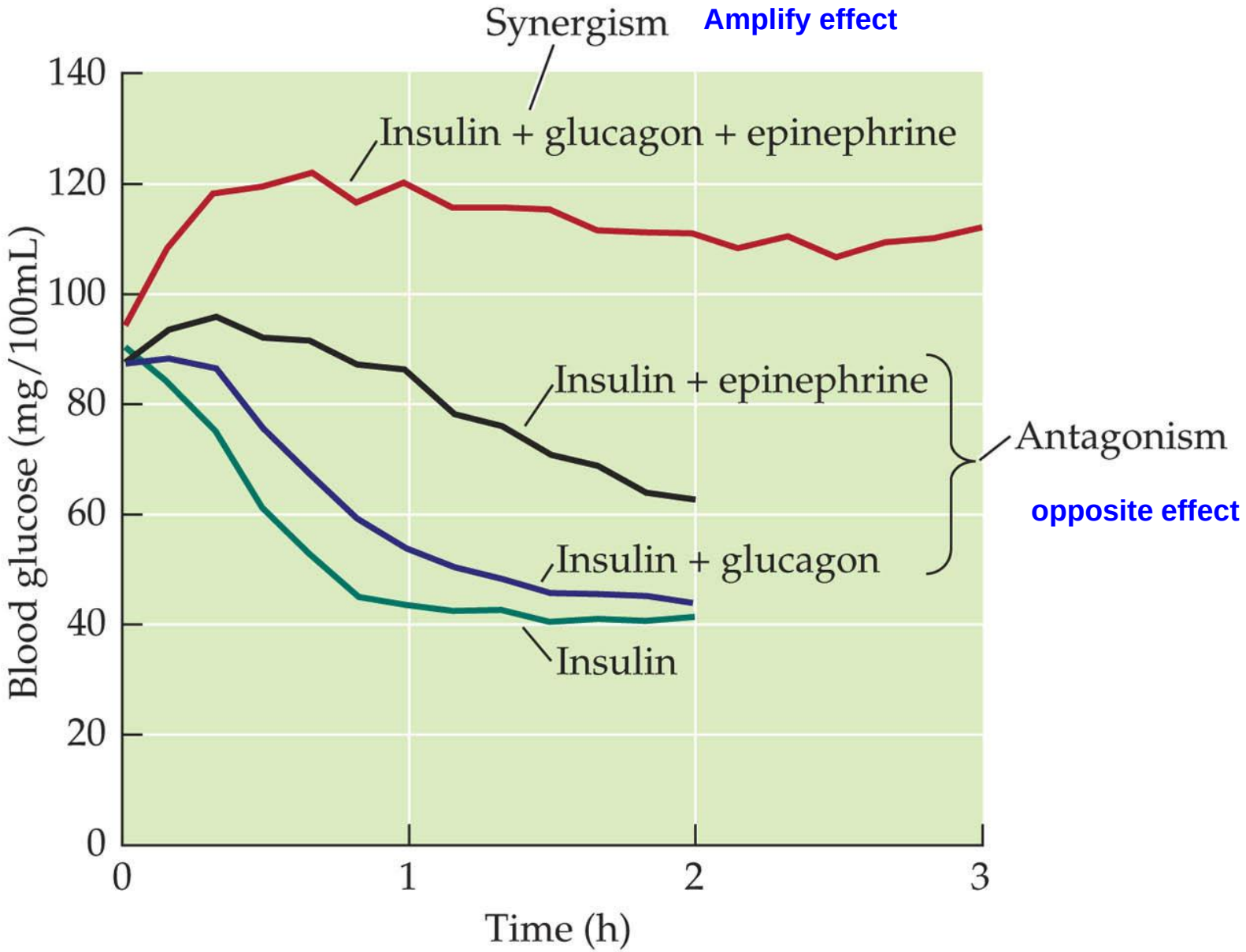
Oxytocin (uterus contraction and milk ejection)

Both hormonal and neural mechanisms modulate the action of the HPA (Hypot-pituit-adrenal) axis

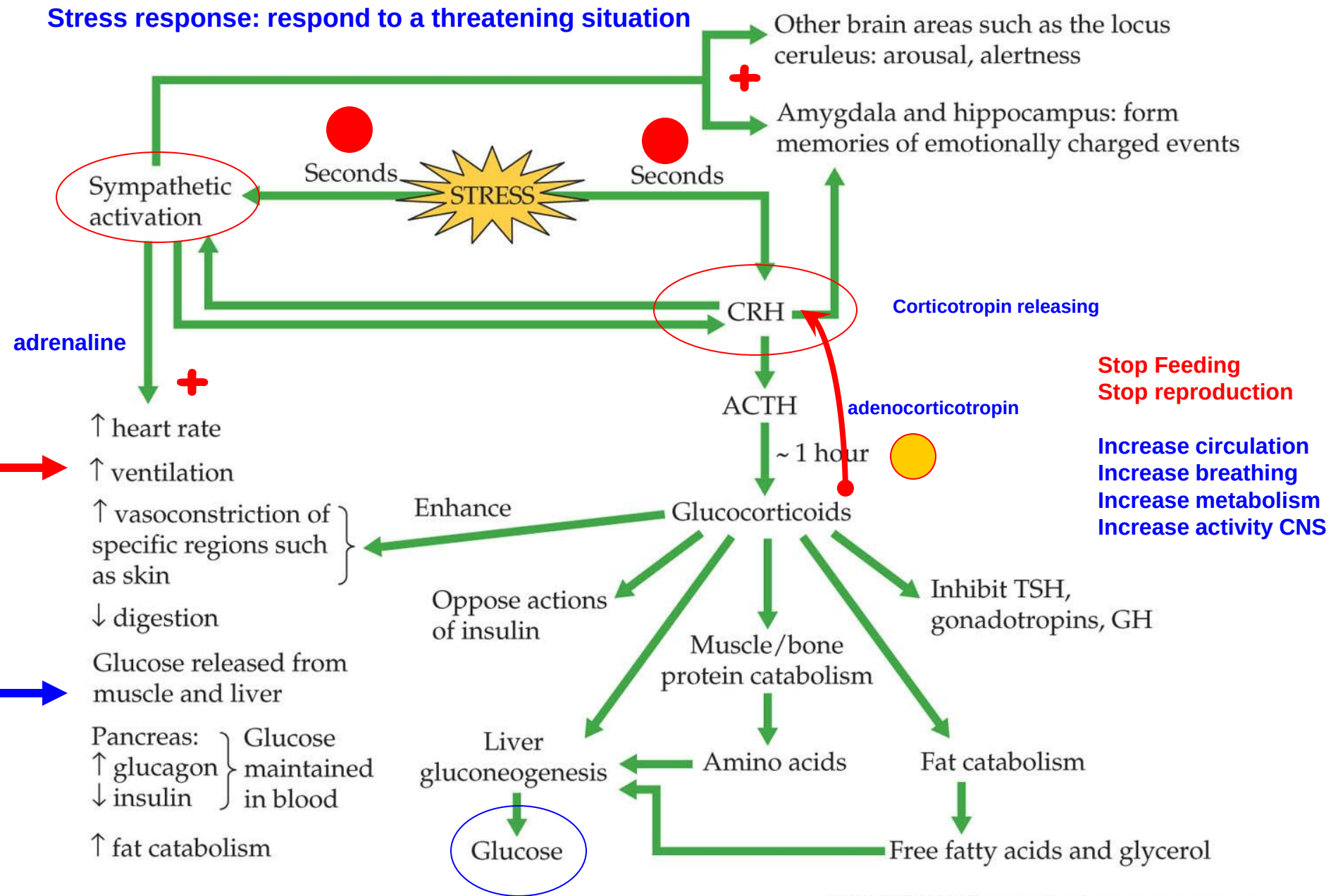
Axis: one endocrine gland (EG) modulating another EG



There is synergism and antagonism among hormones



The mammalian stress response includes two phases



The mammalian stress response and blood losses

Wound and blood loss : blood volume and blood pressure

Blood loss:

Adrenaline: + Heart and blood pressure

↑ vasopressin → ↑ water reabsorption at kidney

↑ aldosterone → ↑ Na reabsorption at kidney

↓

↑ fluid retention

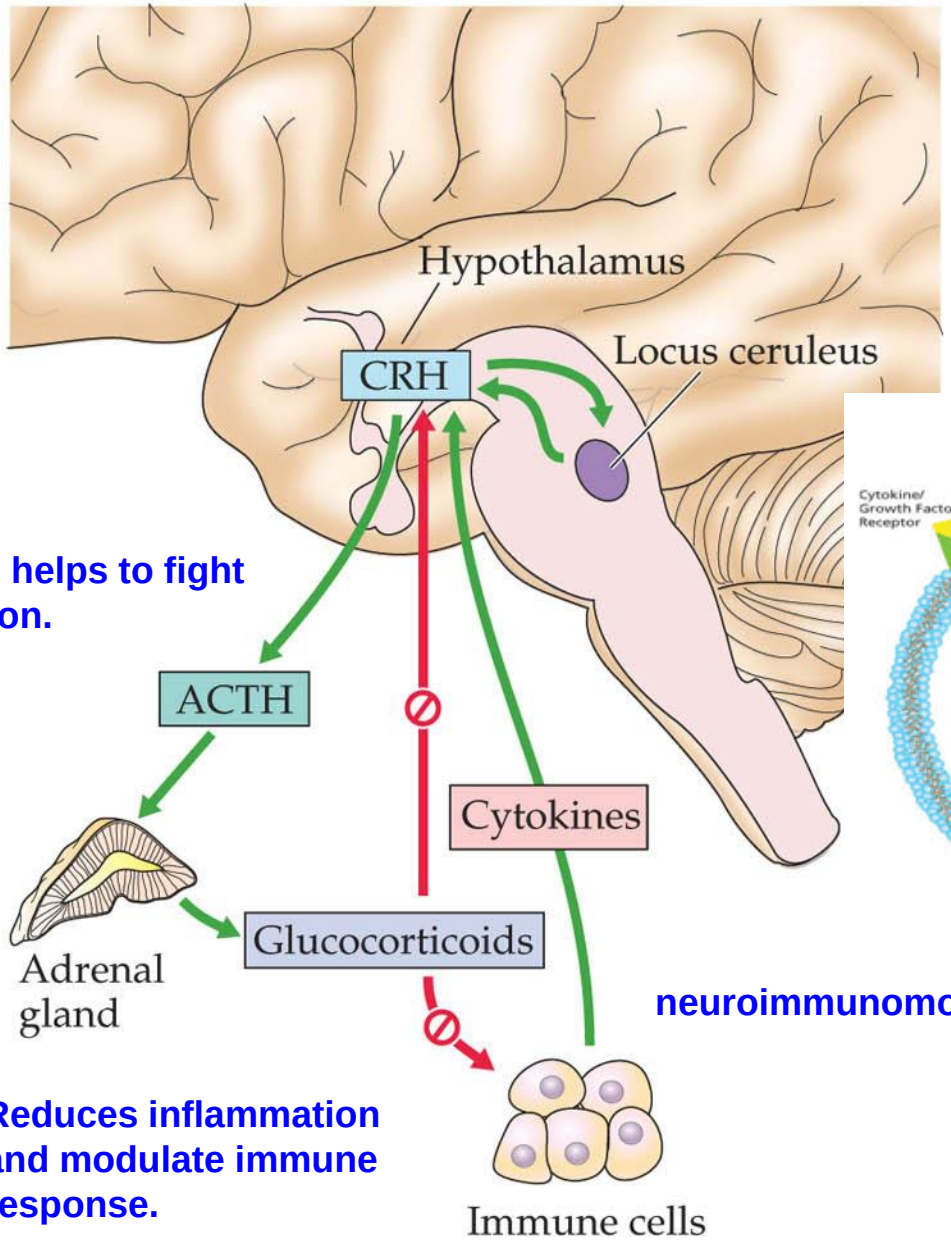
↓

↑ blood volume

↓

↑ blood pressure

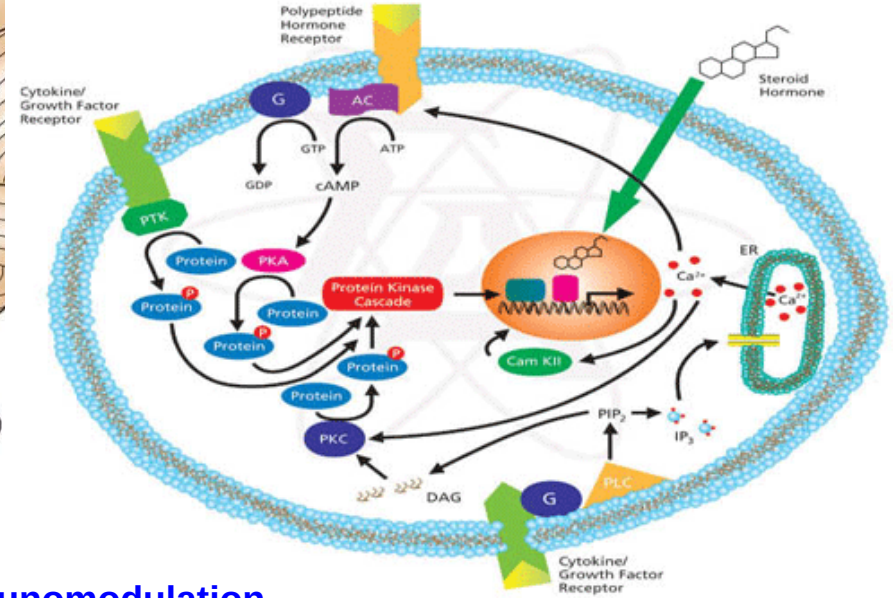
The CNS and the immune system interact during the stress response



Stress helps to fight infection.

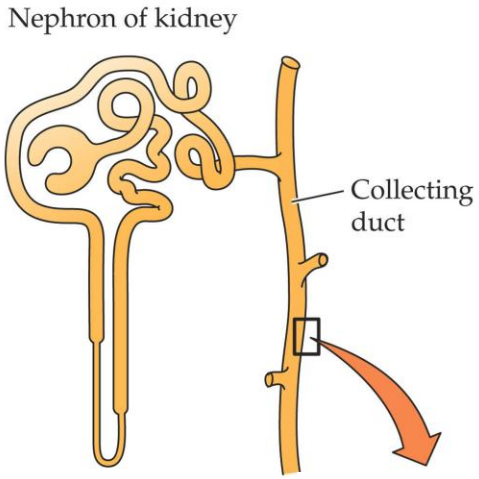
Reduces inflammation and modulate immune response.

Cytokines

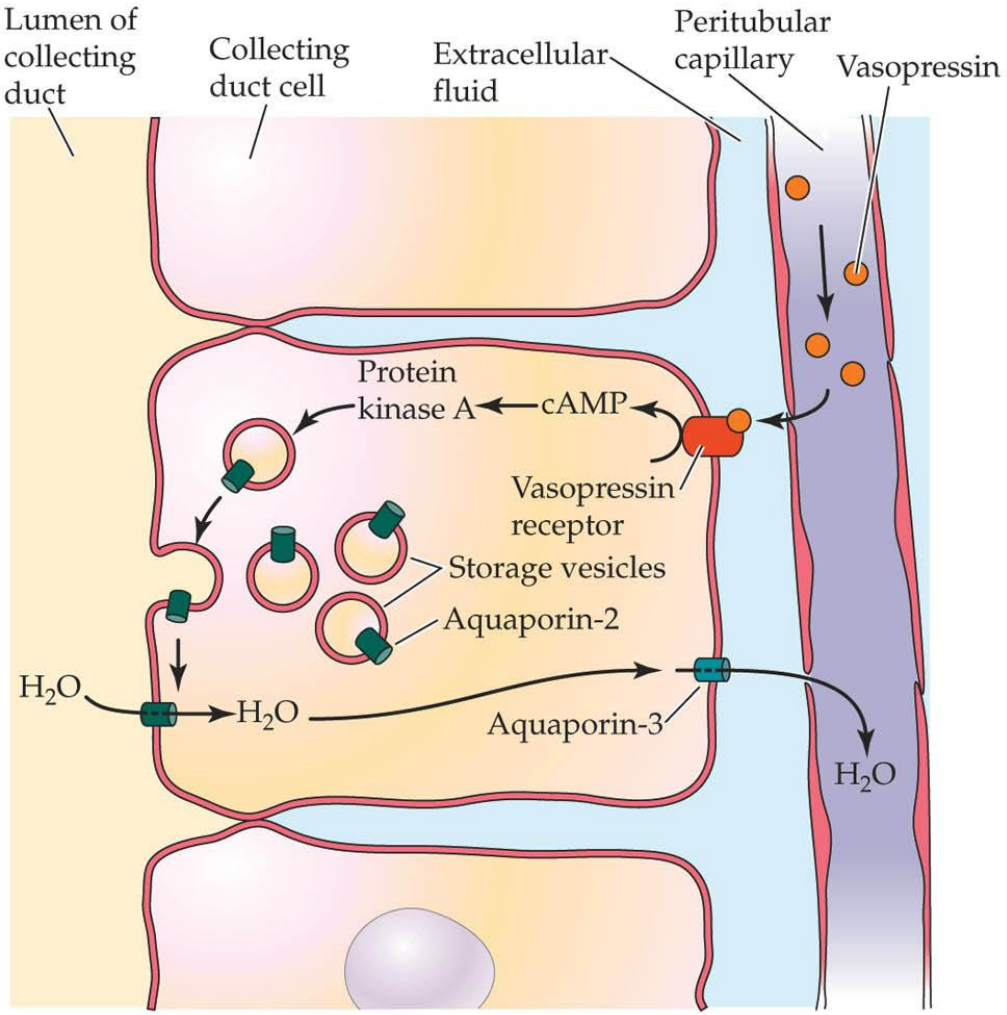


neuroimmunomodulation

Endocrine control of salt and Water Balance



Anti diuretic hormone (Vasopressin) regulates the balance of water



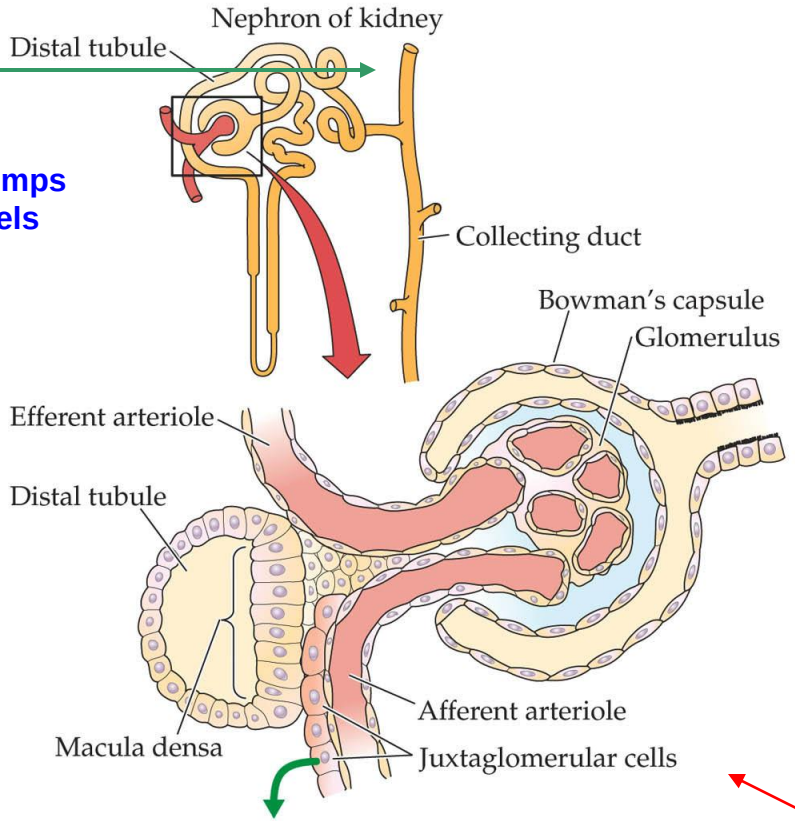
Aquaporin-2 is regulated.

Aquaporin-3 is constitutive.

The renin–angiotensin–aldosterone system

Aldosterone stimulates the conservation of sodium

Sodium pumps and channels



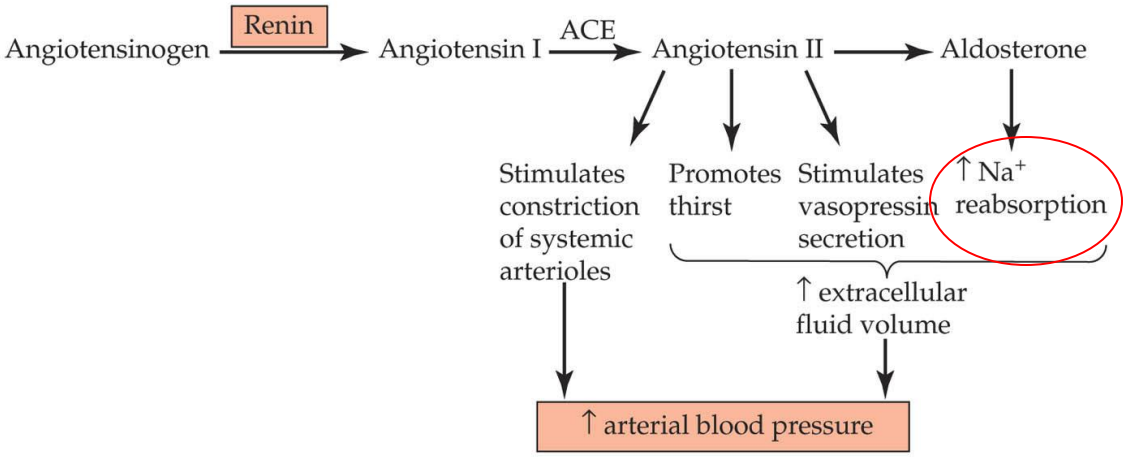
Angiotensinogen : large protein

↓

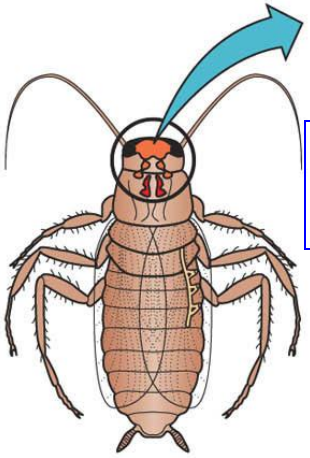
Angiotensin I : 10 AA

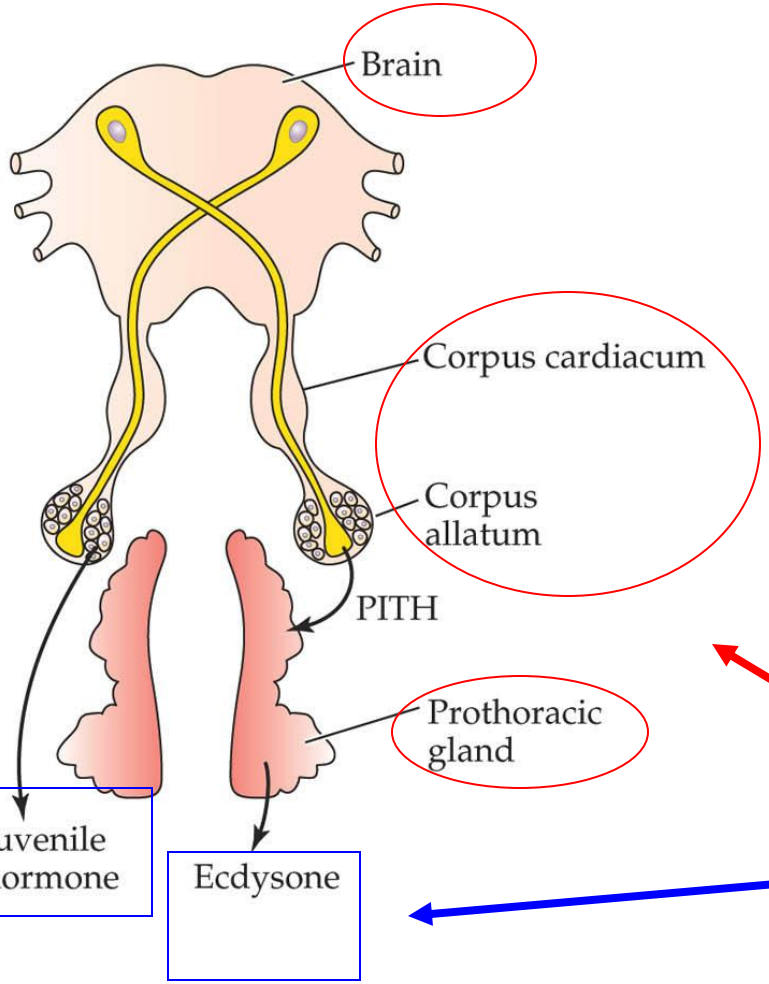
↓

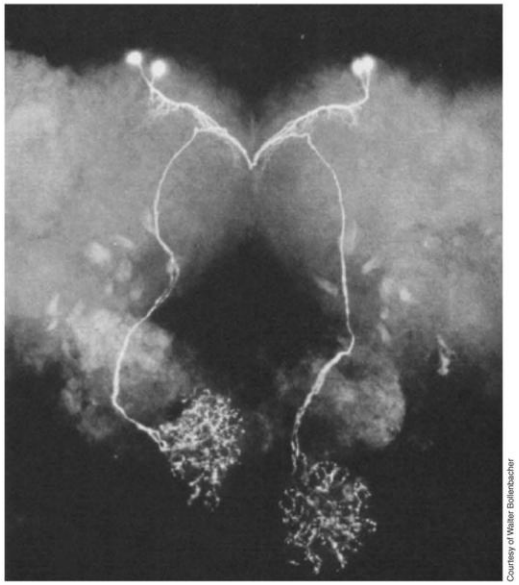
Angiotensin II : 8 AA



Endocrine & neuroendocrine structures involved in control of insect reproduction and metamorphosis







3 tissues

2 hormones

Endocrine control of insect metamorphosis