



Biology Lecture 5 – The Endocrine System

Examcrackers MCAT Comprehensive Course, Charles Feng
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Introduction

- SLOWER, LESS DIRECT, LONGER LASTING
- Hormones released into bloodstream, bind to specific receptors on membrane or inside cell
- Can regulate action both by regulating amount of hormone and amount of receptors
- *Negative feedback*: hormone levels always RESPOND to something, not create it

Peptide hormones: made in rough ER, secreted by Golgi

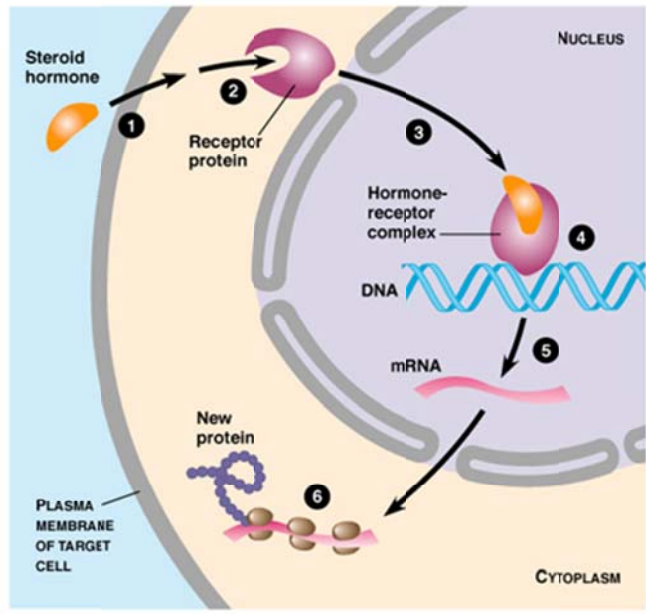
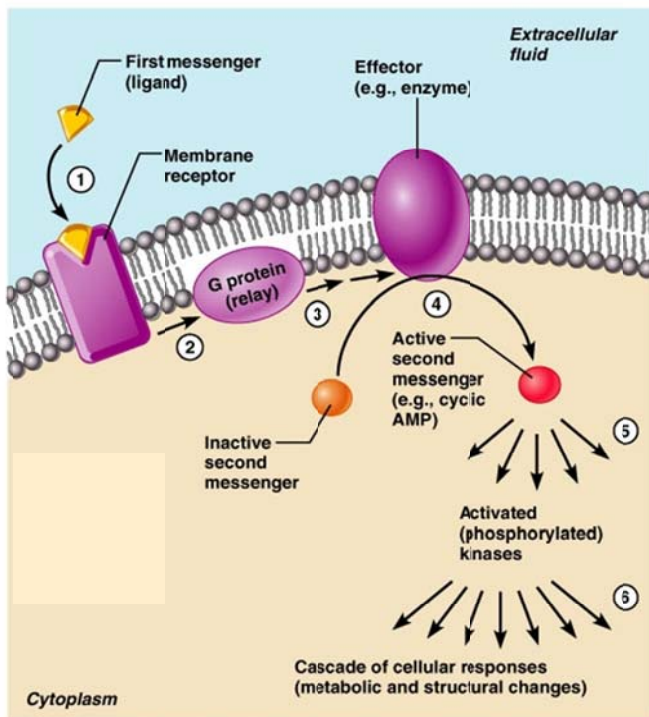
- Water soluble: dissolves in blood, acts on membrane-bound receptors
- Often activates second messenger system within cell

Steroid hormones: made in smooth ER/mitochondria

- Water insoluble: transported by proteins in blood, acts on receptors in cytosol
- Receptor-hormone complex enters nucleus and modifies transcription

Tyrosine derivatives: made in cytosol/rough ER

- Includes *thyroid hormones* and *catecholamines*
- Thyroid hormones are water insoluble: transported by proteins in blood, acts on receptors in cytosol
- Catecholamines are water soluble: dissolves in blood, acts on membrane-bound receptors





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Anterior Pituitary

- Located beneath hypothalamus, which controls secretion of AP hormones
- Secretes peptide hormones
- FLAT PIG

FSH (follicle stimulating hormone) - grows follicles in female, sperm in male

LH (leutinizing hormone) - causes ovulation, stimulates sex hormone secretion

ACTH (adrenocorticotropin) - stimulates adrenal cortex to release glucocorticoids

TSH (thyroid stimulating hormone) - causes thyroid to release T3, T4

Prolactin - stimulates milk production

(I = nothing)

GH (growth hormone) - cell growth all over body (uses fat + glucose; builds protein)

Posterior Pituitary

- Located beneath hypothalamus, hormones stored here actually produced in hypothalamus
- Secretes peptide hormones

Oxytocin - causes uterine contractions, milk ejection from breast

ADH (antidiuretic hormone/vasopressin) - increases permeability of collecting ducts, concentrates urine, increases blood pressure

Adrenal Cortex

- Adrenal glands are above the kidneys, cortex is the outside of the gland
- Secretes mineral corticoids/glucocorticoids (both steroid hormones)

Aldosterone (mineral corticoid) - increases Na^+ reabsorption, K^+ secretion in collecting tubules, raises blood pressure

Cortisol (glucocorticoid) - increases blood glucose by causing gluconeogenesis in liver, degrades adipose tissue and proteins (stress hormone)

Adrenal Medulla

- Inside of adrenal glands
- Secretes catecholamines which are water soluble tyrosine derivatives

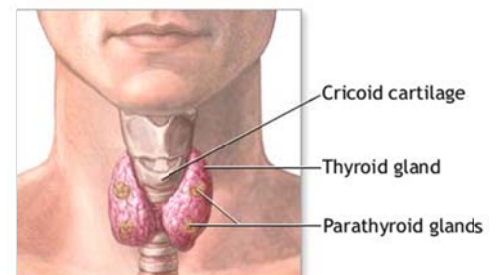
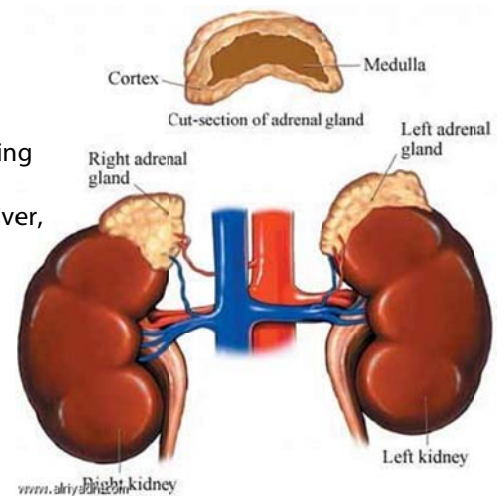
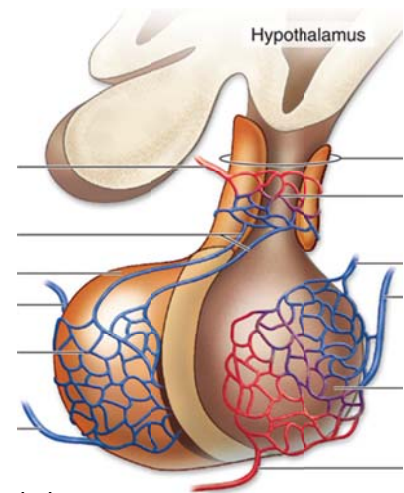
Epinephrine/Norepinephrine (adrenaline/noradrenaline) - vasoconstrictors for internal organs, vasodilators of skeletal muscle (fight or flight response)

Thyroid

- Located near larynx

T3/T4 (triiodothyronine/thyroxine) - water insoluble tyrosine derivatives that increase basal metabolic rate

Calcitonin - peptide hormone that decreases blood calcium (“tones down” calcium levels)





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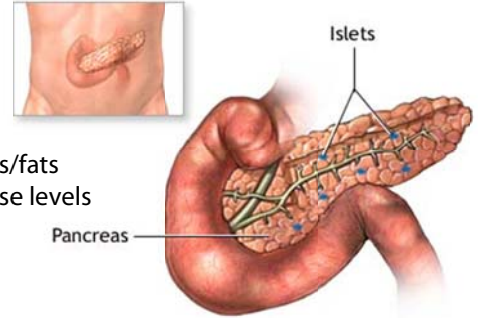
Pancreas

- Secretes peptide hormones

Insulin - released by beta-cells, causes cellular uptake of glucose everywhere

except neurons, decreasing blood glucose levels; also causes storage of amino acids/fats

Glucagon - released by alpha-cells, opposite effect as insulin, increases blood glucose levels



Parathyroid

- Secretes peptide hormones

PTH (parathyroid hormone) - increases blood calcium by breaking down bone, increasing reabsorption in kidneys

Things that increase blood glucose - TENGGG

- Thyroid hormones aka T3, T4
- Epinephrine
- Norepinephrine
- Glucagon
- Glucocorticoids aka cortisol
- Growth hormone
- (Insulin decreases blood glucose)

Things that affect blood calcium

- Calcitonin decreases
- PTH increases

Male reproductive system

- In testes, FSH causes production of sperm, LH causes release of testosterone
- Testosterone - stimulates sperm production, causes growth of pubic hair/penis/larynx
- Pathway of sperm: SEVEN UP
- Seminiferous tubules -> epididymus -> vas deferens -> ejaculatory duct -> (nothing) -> urethra -> penis

Female reproductive system - FOL(d) M(a)PS

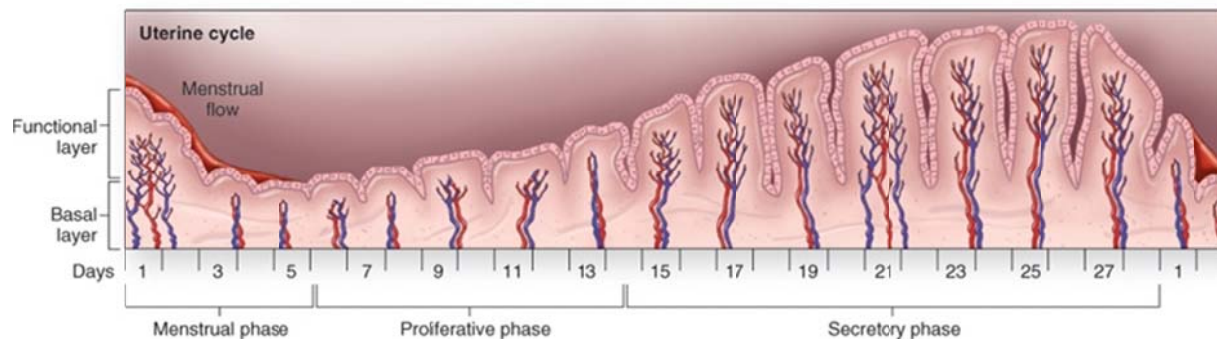
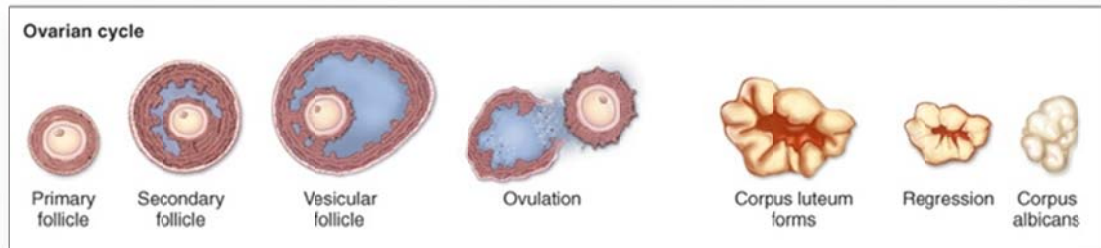
- In ovaries, FSH causes *zona pellucida* to grow around egg, LH causes release of estrogen
- Ovarian cycle
 - *Follicular phase*: follicle grows around primary oocyte, zona pellucida is formed
 - *Ovulatory phase*: follicle ruptures releasing secondary oocyte
 - *Luteal phase*: corpus luteum develops, if egg fertilized then starts secreting estrogen/progesterone; if egg not fertilized then degrades into corpus albicans
- Menstrual cycle
 - *Menstruation*: endometrium (lining of uterus) degrades
 - *Proliferative phase*: endometrium starts to grow
 - *Secretory phase*: (starts at ovulation) endometrium grows even more
- Hormone levels:
 - FSH/LH increase rapidly right before ovulation, causing the *LH surge* which causes ovulation
 - Estrogen is at highest levels after ovulation (produced by corpus luteum)
 - Progesterone is at highest levels after ovulation (produced by corpus luteum)



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Fertilization "must be good - morula blastula gastrula"

- Occurs in *Fallopian tubes*
- *Determination*: cells start on a particular developmental path
- *Differentiation*: cells becoming more and more specialized
- *Apoptosis*: programmed cell death which is necessary for nervous system/hands/feet growth

Steps:

- Enzymes in tip of sperm (*acrosome*) digest *zona pellucida*, lets sperm enter primary oocyte
- Primary oocyte divides into *ovum*, once sperm nucleus enters it becomes *zygote*
- Zygote undergoes *cleavage* which is many rapid cycles of mitosis -> forms *morula*
- Fluid filled sac forms within morula -> forms *blastula/blastocyst*
- Blastocyst implants in uterus
- Cells start to move around in embryo -> forms *gastrula* which has 3 germ layers (below)
- Mesoderm forms *notochord* which eventually causes creation of spinal cord/brain -> forms *neurula*

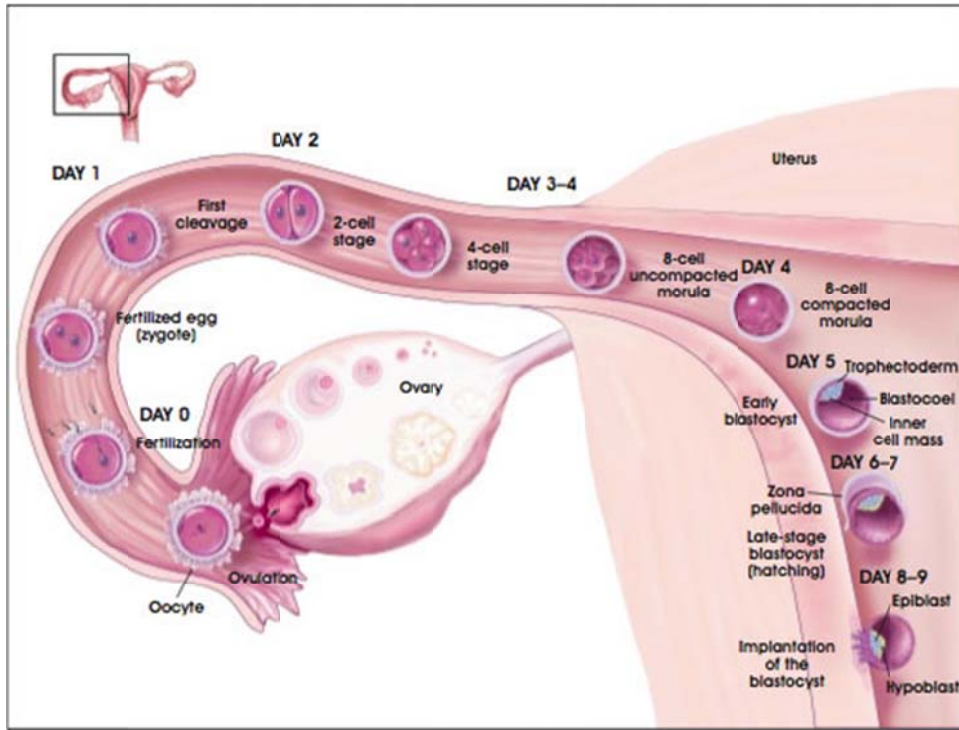
Right after implantation:

- Egg secretes *HCG* (human chorionic gonadotropin) which prevents corpus luteum degrading
- *Placenta* forms in uterus which starts to produce estrogen/progesterone



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Germ layers:

- *Ectoderm* turns into skin/nails/teeth/nervous system
- *Endoderm* turns into digestive lining/liver/pancreas
- *Mesoderm* turns into the rest (muscle/bone/etc)

