Animal Science 434
Reproductive Physiology

Endocrinology: Part A

What is the function of the endocrine system?

Integration of Body Functions

- nervous and endocrine systems are similar
- nervous system
  - » seconds
- endocrine system
  - » minutes and hours

Neuro-endocrine Response

Manipulation of the Endocrine System

- Hormones can be used to regulate body functions
  - » growth (anabolic steroids)
  - » lactation (GH or STH)
  - » birth control (Estradiol, Progesterone)
  - » estrous cycle ($PGF_2\alpha$)
  - » superovulation and embryo transplant (FSH,eCG)
  - » parturition (oxytocin)

Endocrine Gland

- A ductless gland
- Secretes substances (hormones) into blood or lymph that affect cells elsewhere in the body
- The secretion does not involve loss of tissue

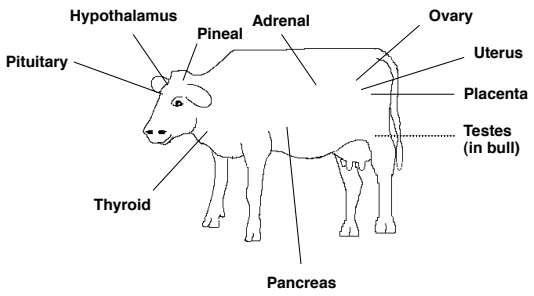
Exocrine Gland

- A gland with ducts that are used for secretion

Hormone

- Substance produced by endocrine gland
- Acts on cells, tissues or organs at a place other than where produced
- Acts as a catalyst.

Endocrine Glands



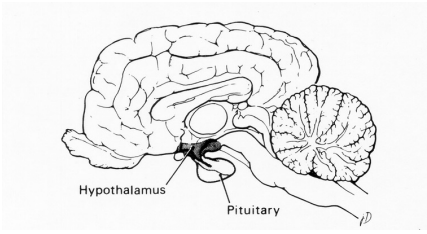
Classification and Properties of Hormone

A. Site of Production
B. Type of action
   1. Primary hormone of reproduction
   2. Metabolic hormone
C. Chemical Structure
   1. General structure
      - Proteins and polypeptides
      - Steroids
      - Fatty acids
      - Modified amino acid
   2. Size

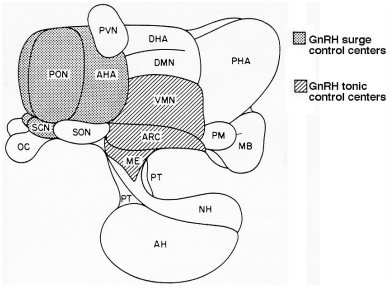
Classification and Properties of Hormone

A. Site of Production
B. Type of action
   1. Primary hormone of reproduction
   2. Metabolic hormone
C. Chemical Structure
   1. General structure
      - Proteins and polypeptides
      - Steroids
      - Fatty acids
      - Modified amino acid
   2. Size

Location of the Hypothalamus and Pituitary Gland



Hypothalamus



Function of Hypothalamus

- appetite
- thirst
- body temperature
- vasomotor activity
- emotion
- use of body nutrient reserves
- activity of intestine
- sleep
- sexual behavior
- Production and release of releasing hormones

Releasing Hormones of the Hypothalamus

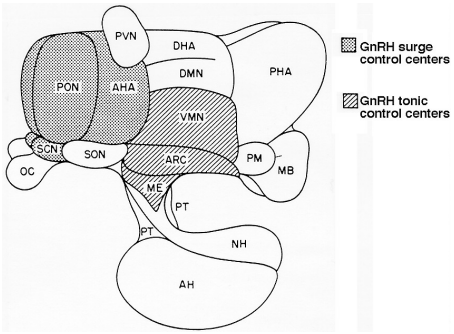
A. Structure
- short chain polypeptides (3 - 44 amino acids)

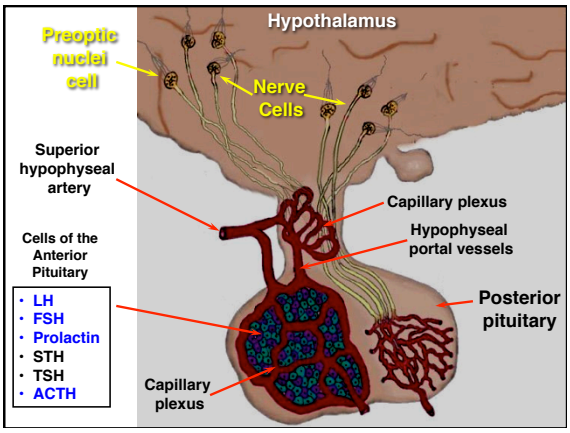
B. General Function
- to cause the release of trophic hormones from the anterior pituitary gland

Releasing Hormones of the Hypothalamus

C. Hormones
- Gonadotropin releasing hormone (GnRH)
  - » LH, FSH release
- Thyrotrophin releasing hormone (TRH)
  - » TSH and prolactin release
- Corticotrophin releasing hormone (CRH)
  - » ACTH release
- Growth hormone releasing hormone (GH-RH)
- Somatostatin (growth hormone inhibiting hormone)

Hypothalamus





Hypothalamus and Anterior Pituitary Gland

Anterior Pituitary Hormones

A. Structure
   1. glycoproteins or proteins
B. Hormones
   1. gonadotropins
      » Follicle stimulating hormone (FSH)
      » Luteinizing hormone (LH)
      » Prolactin

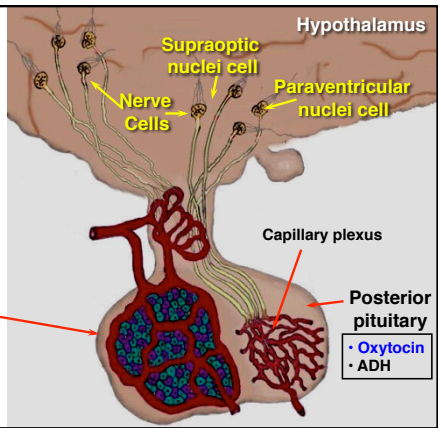
Anterior Pituitary Hormones

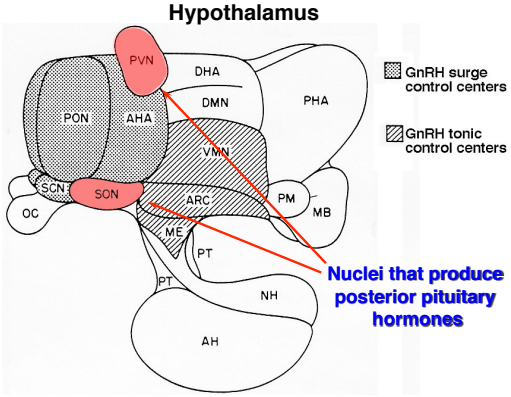
2. Other trophic hormones
   - Adrenal Corticotropin (ACTH)
   - thyroid stimulating hormone (TSH)
   - growth hormone (GH or STH)

Structure of LH, FSH and TSH

- Made of 2 amino acid chains

- α chains are the same
- β chains differ and give specificity





Posterior Pituitary Hormones

A. Structure
- polypeptides (9 amino acids)

B. Hormone
- Oxytocin - contraction of smooth muscle

Placental Hormones

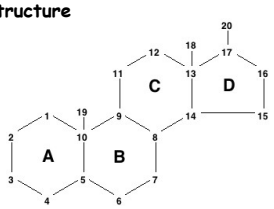
- Equine Chorionic Gonadotropin (eCG)
  - » Formation of accessory CL and maintains pregnancy
- Human Chorionic Gonadotropin (HCG)
  - » Maintains primate CL and pregnancy
- Placental Lactogen (PL)
  - » Development of the mammary gland in the mother
- Steroids - Estrogen and Progesterone

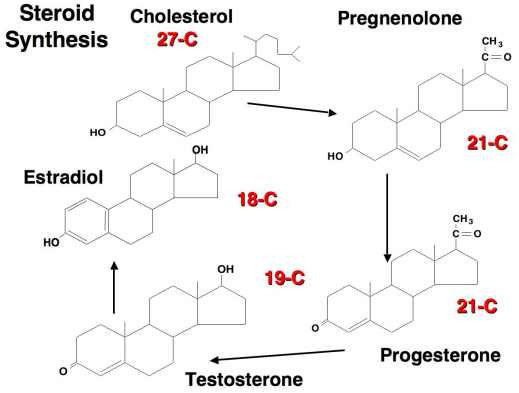
Gonadal Polypeptide Hormones

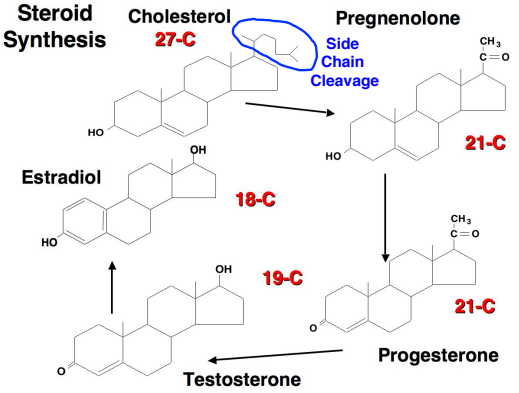
- Relaxin
  - » Secreted by CL during pregnancy.
  - » Parturition
- Inhibin
  - » Inhibits FSH release

Gonadal Steroids

A. General
- » Origin - ovary, testis, adrenal
- » Structure



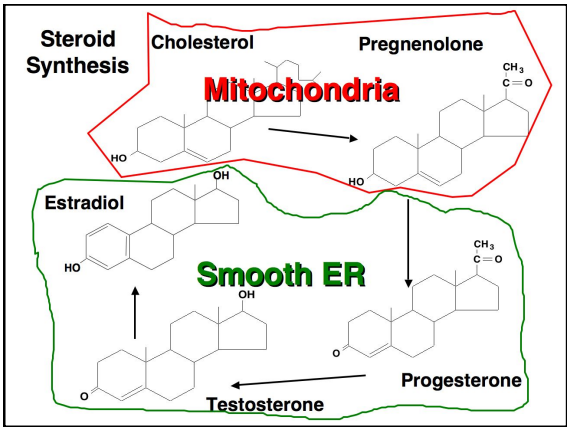




Gonadal Steroids Cont.

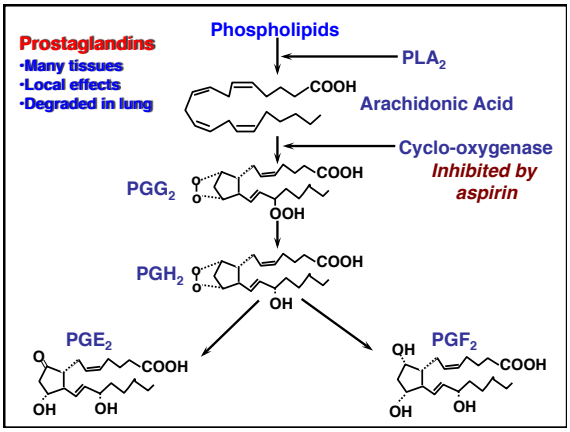
A. General Cont.
- » Solubility
  - – Bound to a binding protein for transport

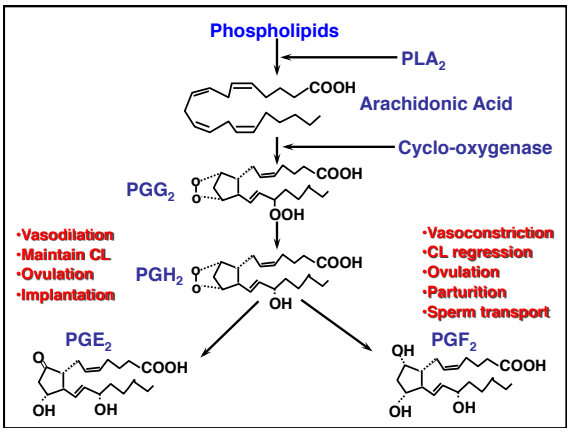
C. Type of Steroids
- » Androgens - Testosterone
- » Estrogen - Estradiol
- » Progestin - Progesterone



Other Hormones

A. Prostaglandins
1. $PGF_{2\alpha}$
2. $PGE_{2\alpha}$





Other Hormones

B. Melatonin
1. Secreted from the pineal gland.
2. Is a modified amino acid
3. Functions to integrate effects of light on reproductive processes.

Other Hormones

C. Human Menopausal Gonadotropin (hMG)

1. Anterior pituitary gland
   - » Secreted in menopause, FSH-like activity
   - » Isolated from urine
     a. Perganol - superovulation

Classification and Properties of Hormone

A. Site of Production

B. Type of action

1. Primary hormone of reproduction
   (FSH, LH, estradiol, progesterone)
2. Metabolic hormone
   (thyroxin, insulin, STH)

Classification and Properties of Hormone

- Chemical Structure
  - » Polypeptides - hypothalamic
  - » Protein - pituitary, gonad
  - » Steroids - gonad, adrenal
  - » Fatty acid - many sources, prostaglandins
  - » Modified amino acid - pineal

Chemical Structure of Hormones

polypeptide	modified amino acid	protein	sex steroid	fatty acid
GnRh	melatonin	LH	Estradiol	$PGF_{2\alpha}$
TRH		FSH	Progesterone	
CRH		Prolactin	Testosterone	
GHRH		ACTH		
Somatistatin		TSH		
Oxytocin		GH or STH		
		Relaxin		
		Inhibin		

Chemical Structure of Hormones

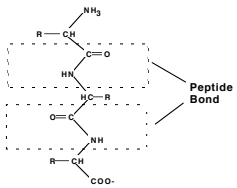
Molecular size of hormones that regulate reproduction

Hormone	Molecular Weight
FSH	30,000 to 37,000
LH	26,000 to 32,000
Prolactin	23,000 to 25,000
HCG	37,700
eCG	28,000
Inhibin	>10,000
Relaxin	6,500
ACTH	4,500
Oxytocin	1,007
GnRH	1,200
Estradiol	300
Testosterone	300
Progesterone	300
PGF	300

$_{2\alpha}$

Chemical Structure of Hormones Cont.

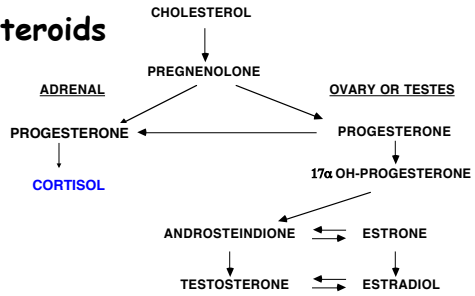
Polypeptide and protein hormones
are made of peptide bonds

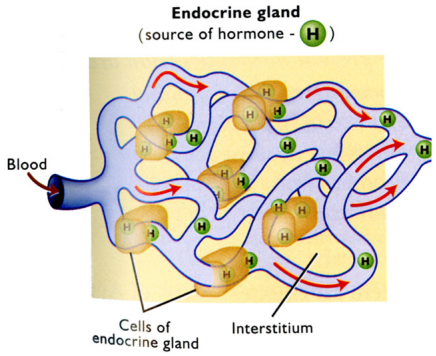


These hormones can not be given orally!

Chemical Structure of Hormones Cont.

Steroids



These hormones can be given orally!

Mechanism of Hormone Action