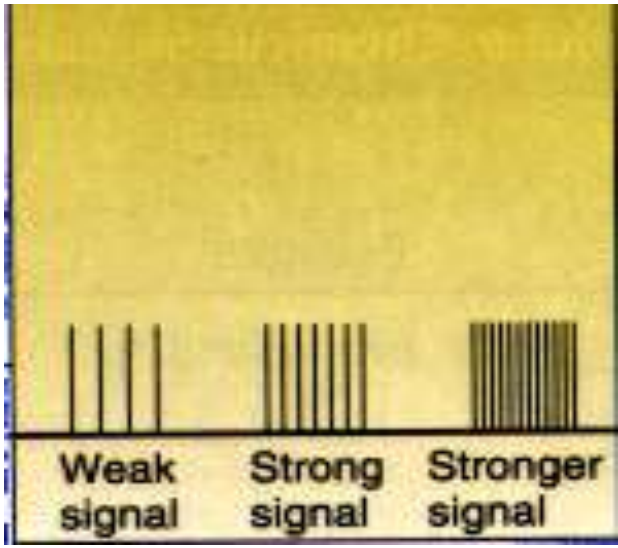
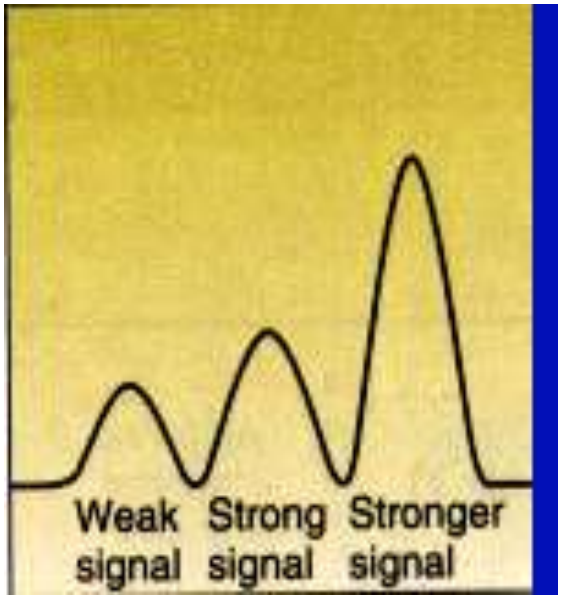
Coordinating Systems

- Coordination of systems involve
  - Nervous System
    - Rapid response
    - Short lasting
    - Uses neurotransmitters
  - Endocrine System
    - Slow response
    - Long lasting
    - Uses hormones
- Homeostasis





What is a Hormone

- A specific chemical compound
- Produced by a specific tissue of the body
- Where it is released in the body fluids
- And carried to a distant target tissue
- Where it affects a pre-existing mechanism
- And is effective is small amounts.

Specific Chemical Substance

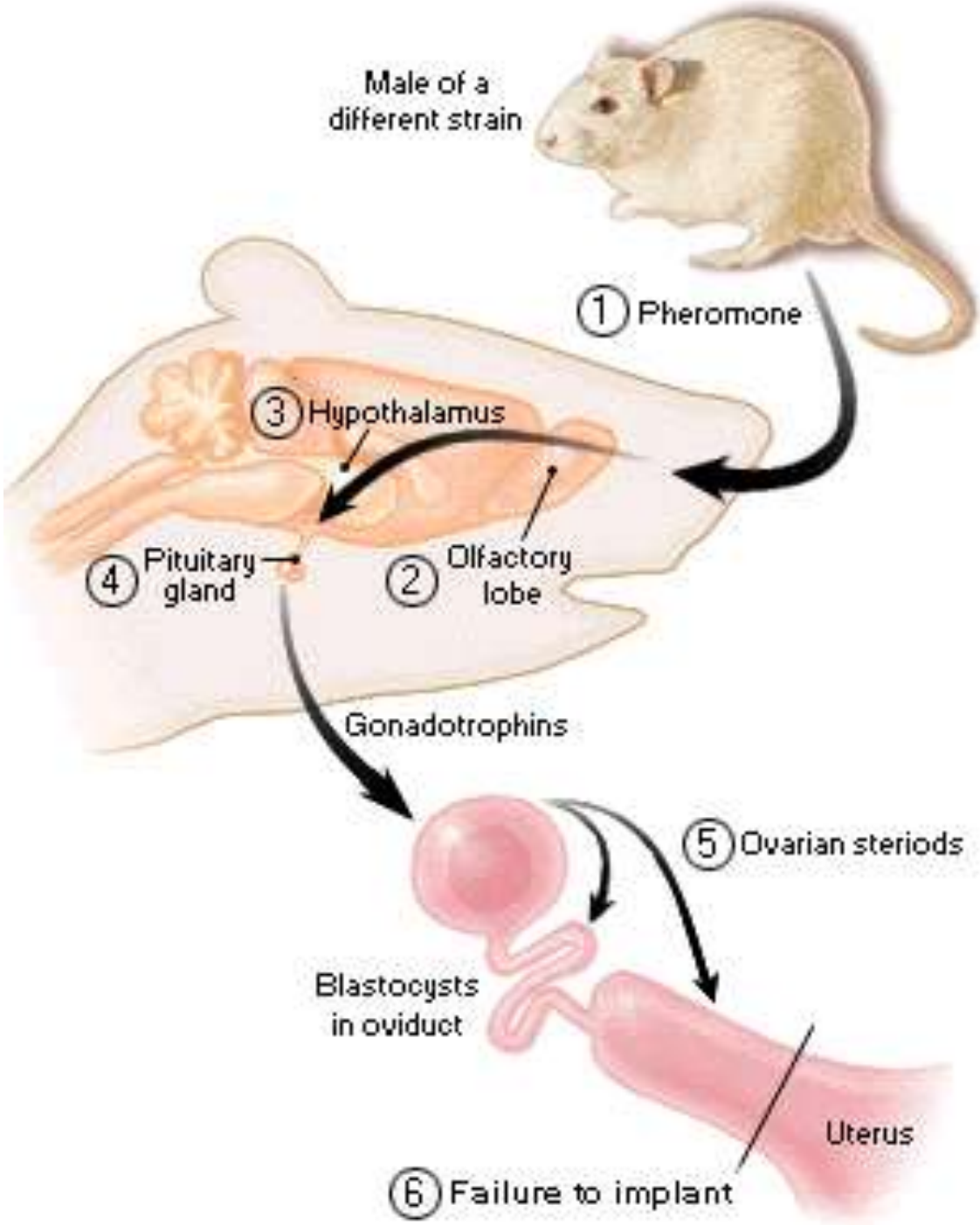
- Proteins and Polypeptides
  - Oxytocin
  - Insulin
- Biogenic amines
  - Thyroxine
  - Catecholamines
- Steroids
  - Estrogens
  - Progestins
  - Androgens
- Eicosanoids
  - Prostaglandins
  - Thromboxanes

Produced by a specific tissue

- Major Endocrine Organs are
  - Hypothalamus
  - Pituitary gland
  - Thyroid gland
  - Parathyroid gland
  - Thymus
  - Adrenal gland
  - Pancreas
  - Ovaries
  - Testes

Released into the body fluids

- Vascularity of endocrine tissue
- Autocrine glands - local to same cells that released the hormone
- Paracrine glands - local to adjacent cells
- Endocrine-Hormone - release into interstitial space, lymphatics, and blood.
- Pheromone - into the air


Male of a different strain
1 Pheromone
3 Hypothalamus
4 Pituitary gland
2 Olfactory lobe
Gonadotrophins
5 Ovarian steriods
Blastocysts in oviduct
Uterus
6 Failure to implant

Carried to a distant target tissue

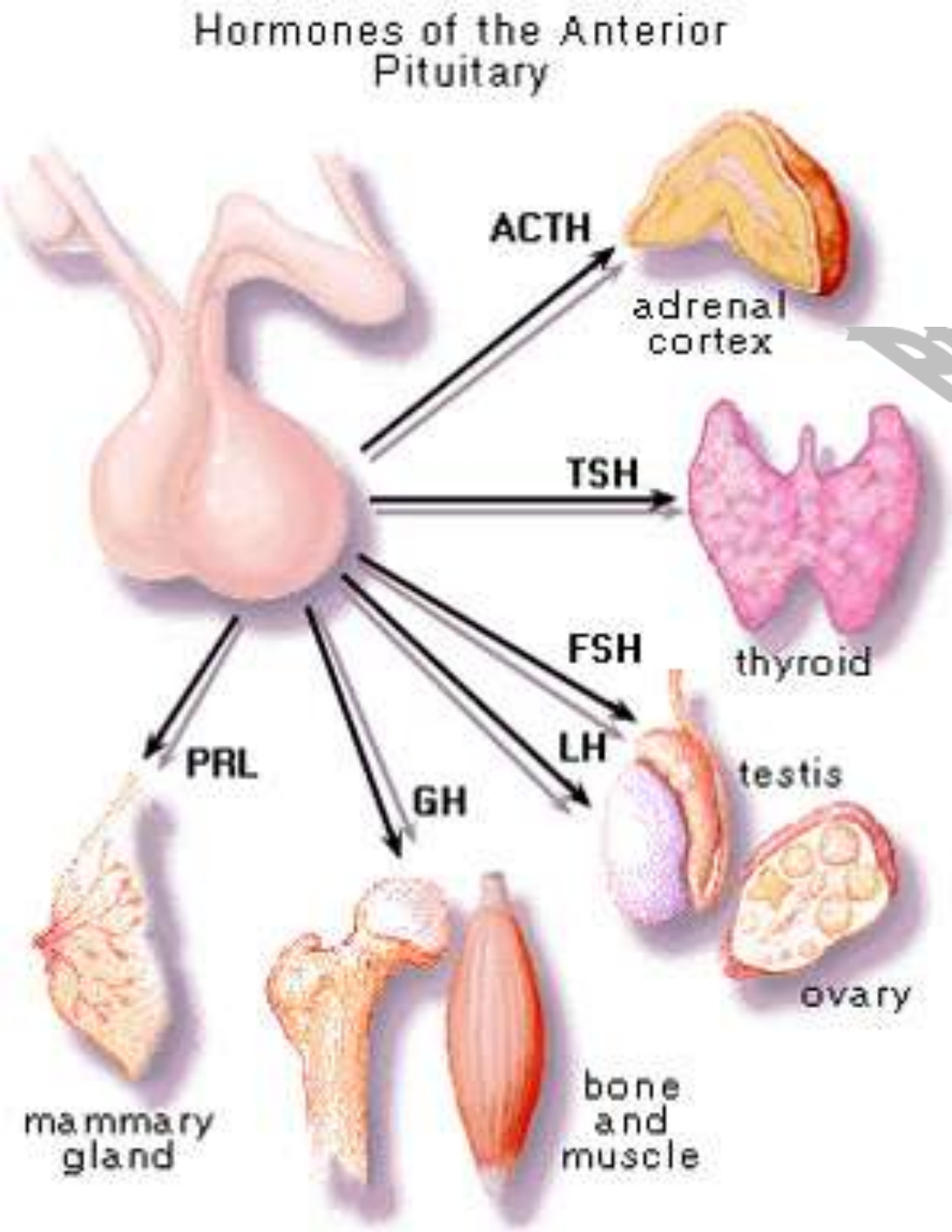
- Blood bound hormonal systems
  - Steroids carried on lipoproteins
  - Polypeptides and Proteins
  - Biogenic amines
- Inactivation System
- Half-life concept
  - Enovid
- Feedback Concept
- How is target tissue recognized
  - Cellular receptors
  - Testosterone Receptors and Sex Determination
  - “Penis by twelve” Syndrome

Effective in Small Amounts

- **Physiological Dosage**
- **Pharmacological Dosage**
- **Distribution over time**
- **How were endocrine secretions discovered?**

Parahormones & Pheromones

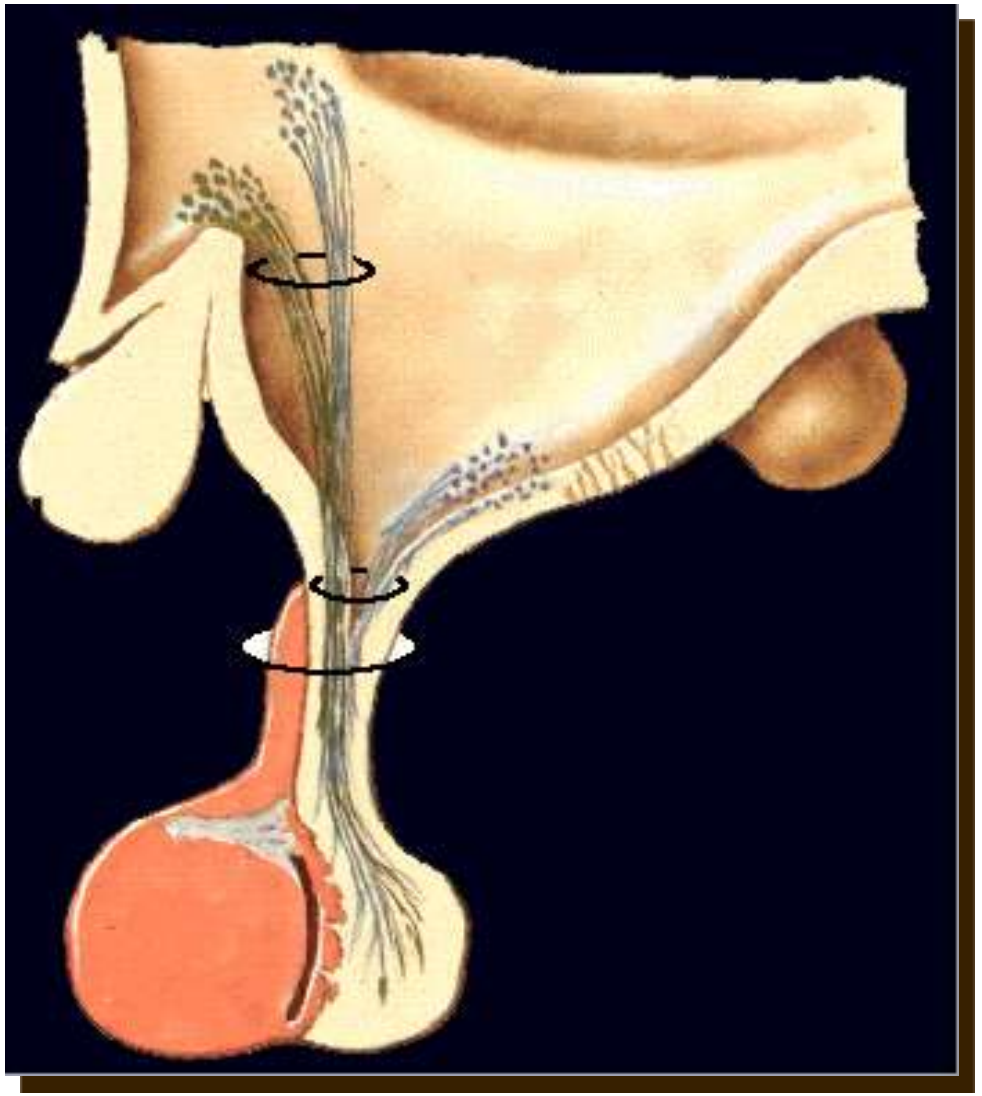
- **Parahormones - Carbon Dioxide**
- **Pheromones - inter-individual hormone**
  - **Sex attractant in moths**
  - **Menstrual synchrony**
  - **Spontaneous abortion induction**
  - **Human Pheromone - Change behavior**
    - **Sex attractant**
    - **Coital behavior**
    - **Production in the male**
    - **Production in the female**



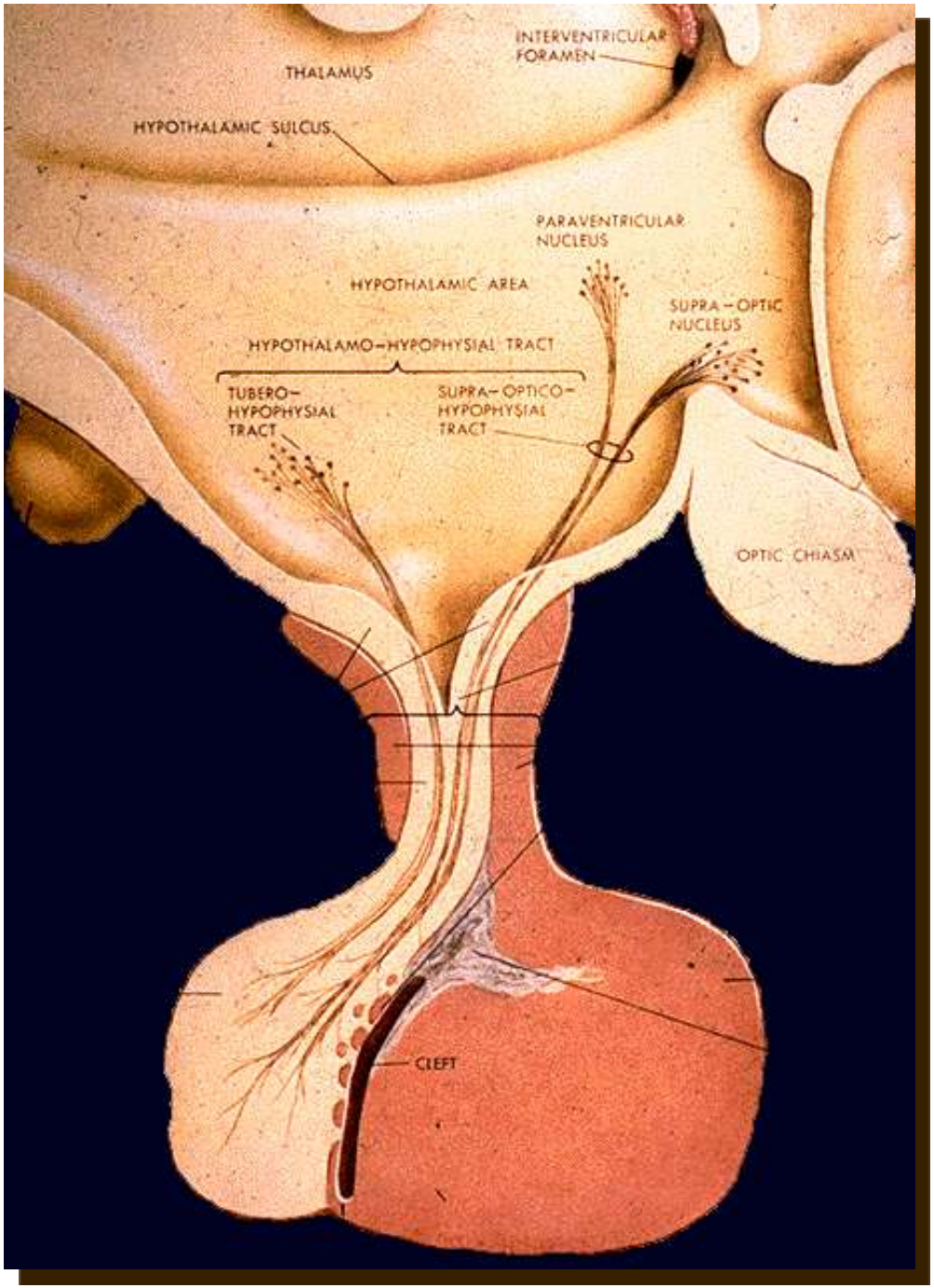
Pituitary Hormones

Pituitary Gland

- Location
  - Sella turcica
  - Floor of the brain
- Parts of the Pituitary Gland
  - Anterior Pituitary
  - Posterior Pituitary
  - Adenohypophysis
  - Neurohypophysis
  - Pars Nervosa
  - Pars Distalis
  - Pars intermedia
  - Pars Tuberalis



- **Location**
  - **Sella turcica**
  - **Floor of the brain**
- **Parts of the Pituitary Gland**
  - **Anterior Pituitary**
  - **Posterior Pituitary**
  - **Adenohypophysis**
  - **Neurohypophysis**
  - **Pars Nervosa**
  - **Pars Distalis**
  - **Pars intermedia**
  - **Pars Tuberalis**

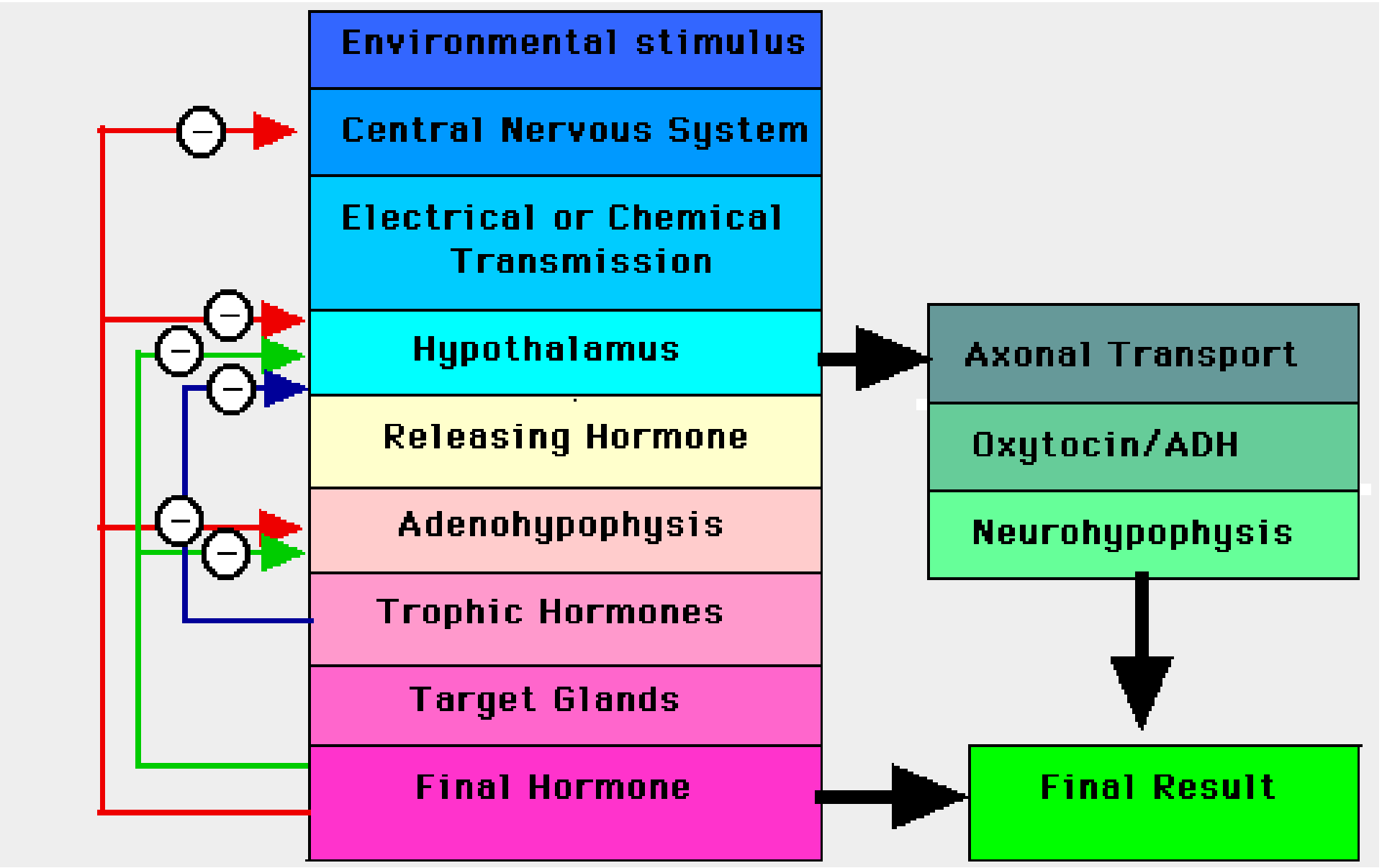


Hormones of Adenohypophysis

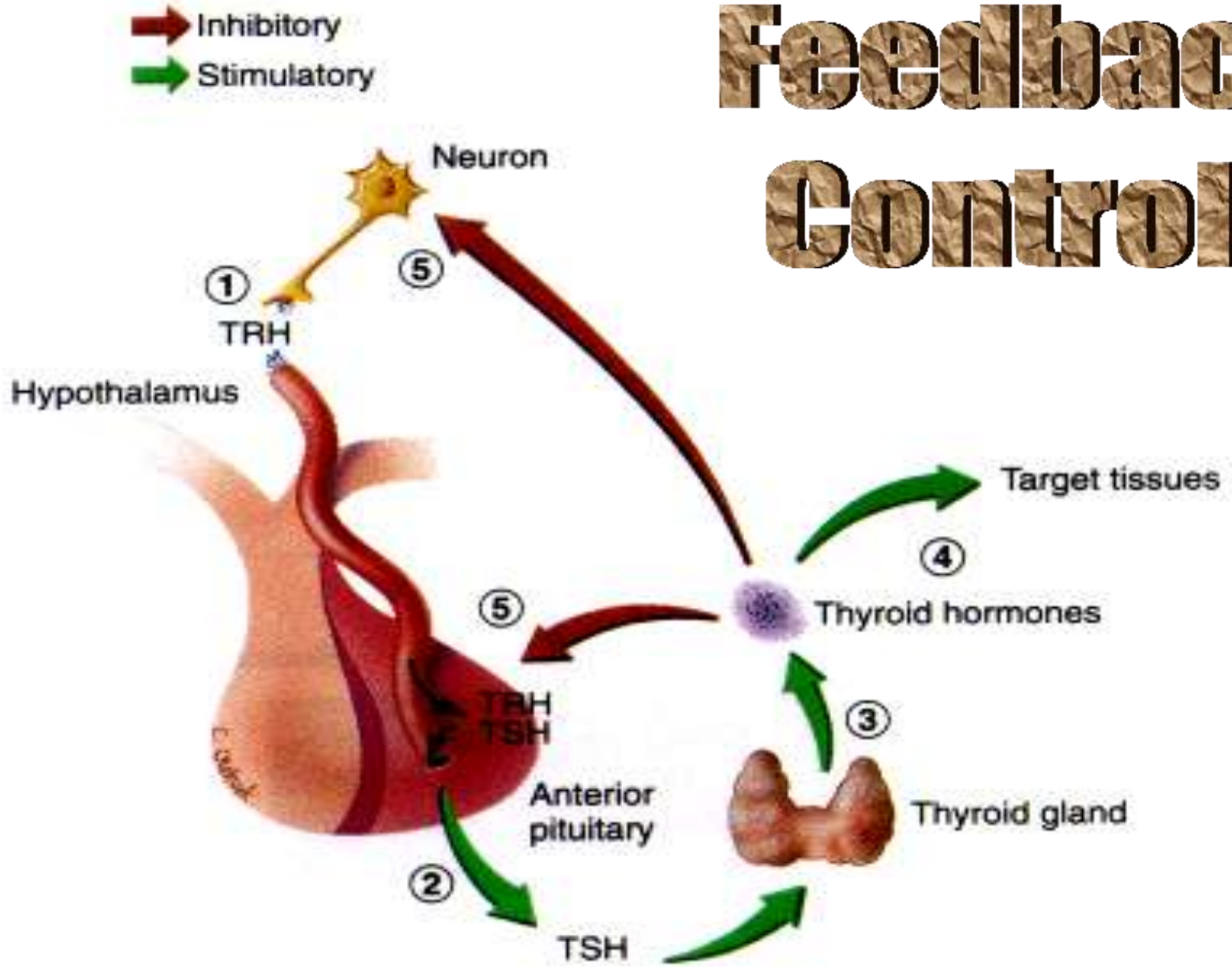
- MSH - Intermediate lobe
- Anterior Lobe Hormones
  - Basophilic and Acidophilic
  - Trophic and nontrophic hormones
  - Growth Hormone
  - Prolactin
  - Thyroid Stimulating Hormone - TSH
  - AdrenoCorticoTrophic Hormone - ACTH
  - Follicle Stimulating Hormone
  - Lutenizing Hormone
- Long Loop and Short Loop Feedback Systems
- Autocrine Feedback Systems

Hypothalamic Controls

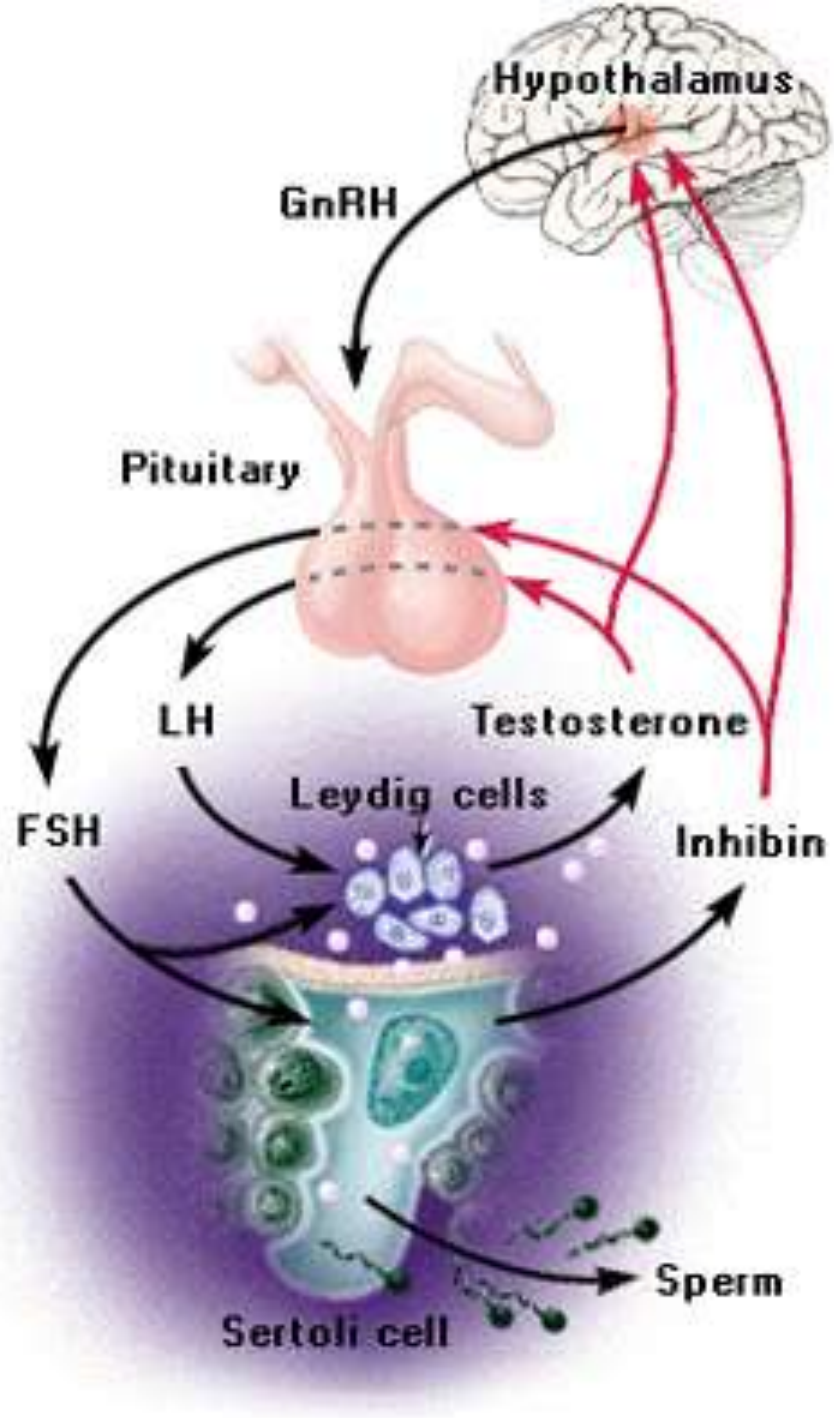
- Hypothalamic Releasing Factors
  - Release stimulating factor
  - Release inhibitory factor
- Each Pituitary Hormone has a set or stimulating and inhibiting factors except the Gonadotropins.
- Prolactin Release Factor = Gonadotropin Inhibitory factor.

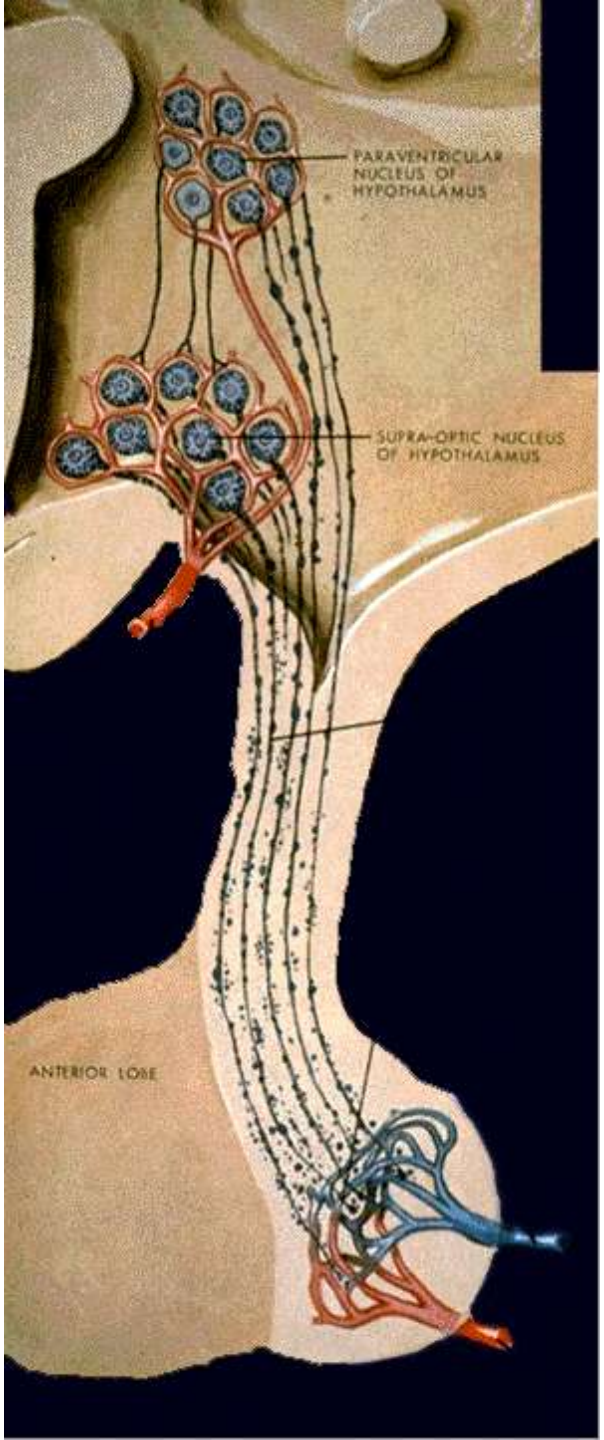

Environmental stimulus
Central Nervous System
Electrical or Chemical Transmission
Hypothalamus
Releasing Hormone
Adenohypophysis
Trophic Hormones
Target Glands
Final Hormone
Axonal Transport
Oxytocin/ADH
Neurohypophysis
Final Result

Feedback Controls



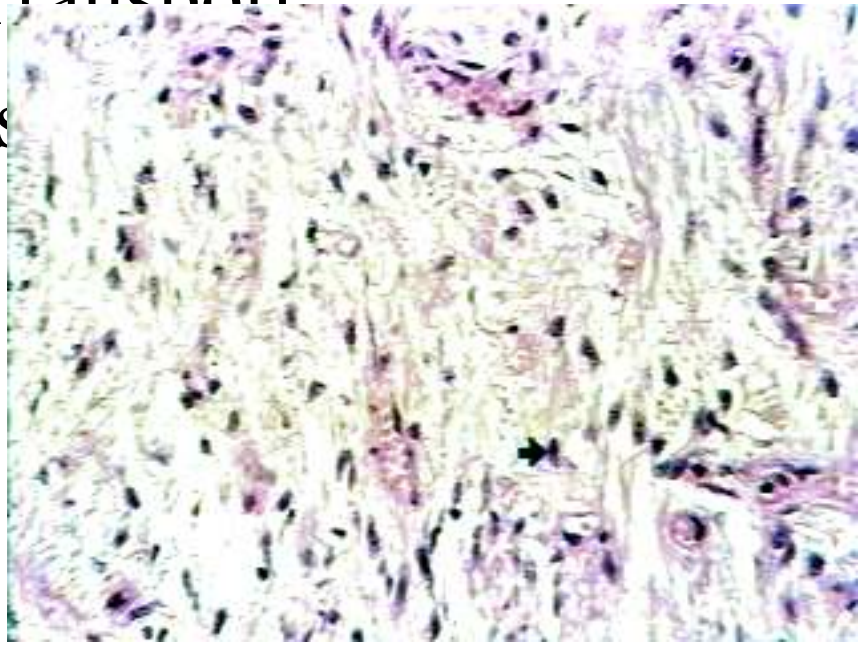
Feedback Controls





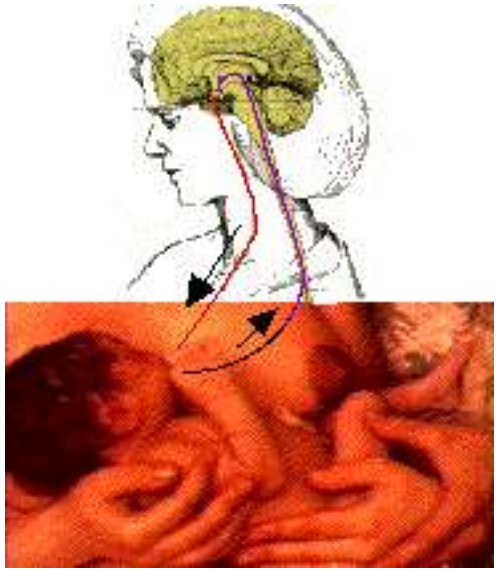
Pars Nervosa

- Hypothalamic centers
  - Supraoptic nucleus
  - Paraventricular nucleus
- Axonal Transport
- Pituicytes



Hormones of the Pars Nervosa

- Releasing factors
  - Release hormones
  - Release inhibiting hormones
- Oxytocin
  - Milk ejection mechanism
  - Uterine Contraction
    - Induction of labor
    - Orgasmic responses
  - Feedback mechanism - Positive
- Vasopressin or ADH - AntiDiuretic Hormone
  - Action on Distal Convoluted tubule and Collecting Duct
  - Pressor effects



Prolactin

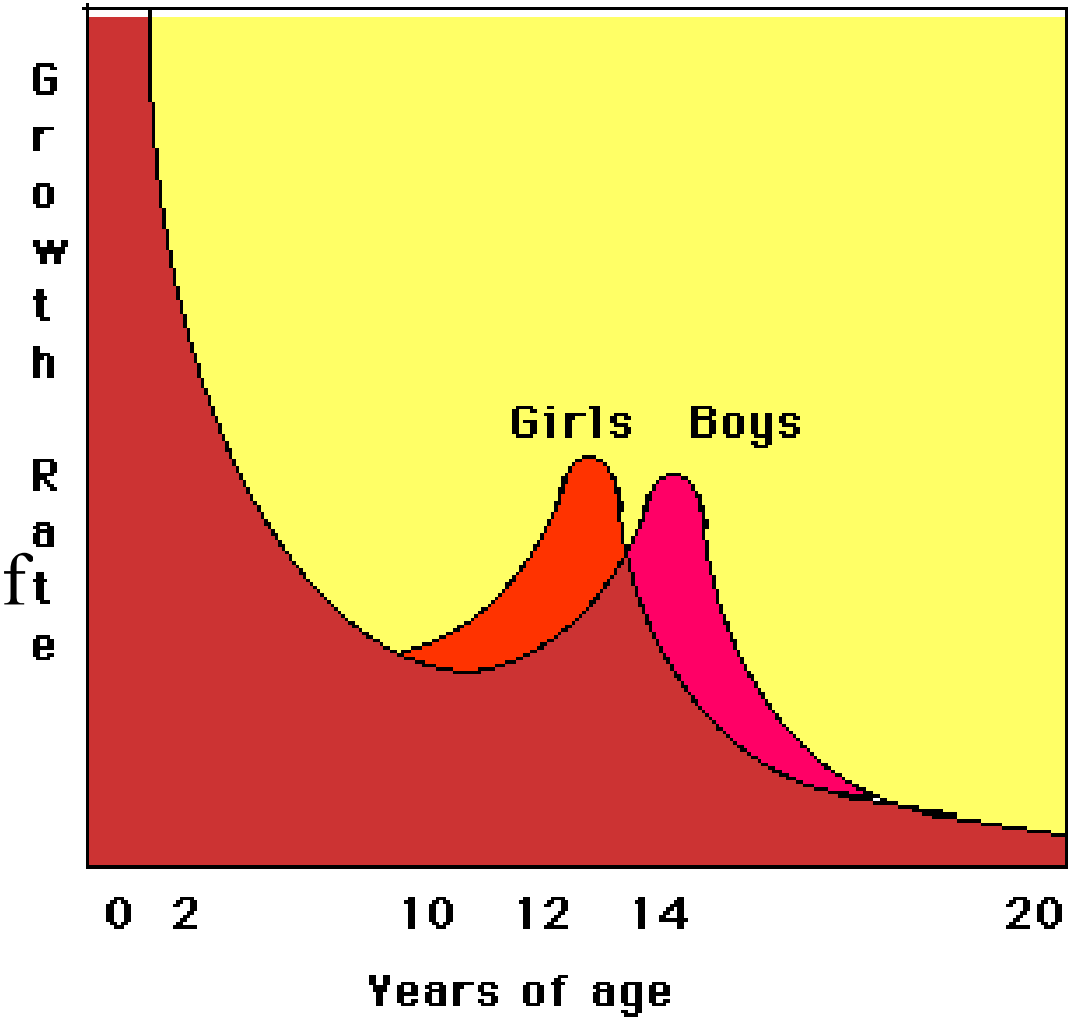
- Prolactin Release Inhibitory Factor
- Prolactin Release Stimulating Factor
- Gonadotrophin Release Inhibiting Factor
- Prolactin hormone - Pregnancy hormone
  - 199 amino acids
  - 20 minute half life
  - Receptor resembles growth hormone receptor
  - Increases milk production
  - Maintains corpus luteum
  - Inhibits ovary
  - Dopamine controls rate of release

Growth Hormone

- Protein mole. wgt. 22,000
- Bound to High Affinity Bound protein and Low Affinity Bound protein.
- Binding compensates for irrating secretion rates.
- Half life varies 6 to 20 minutes.
- Somatomedins - produced by liver - polypeptides - growth factors
- Growth hormone increase IGF-I somatomedin
- What is growth?
- Uptake of Amino Acids

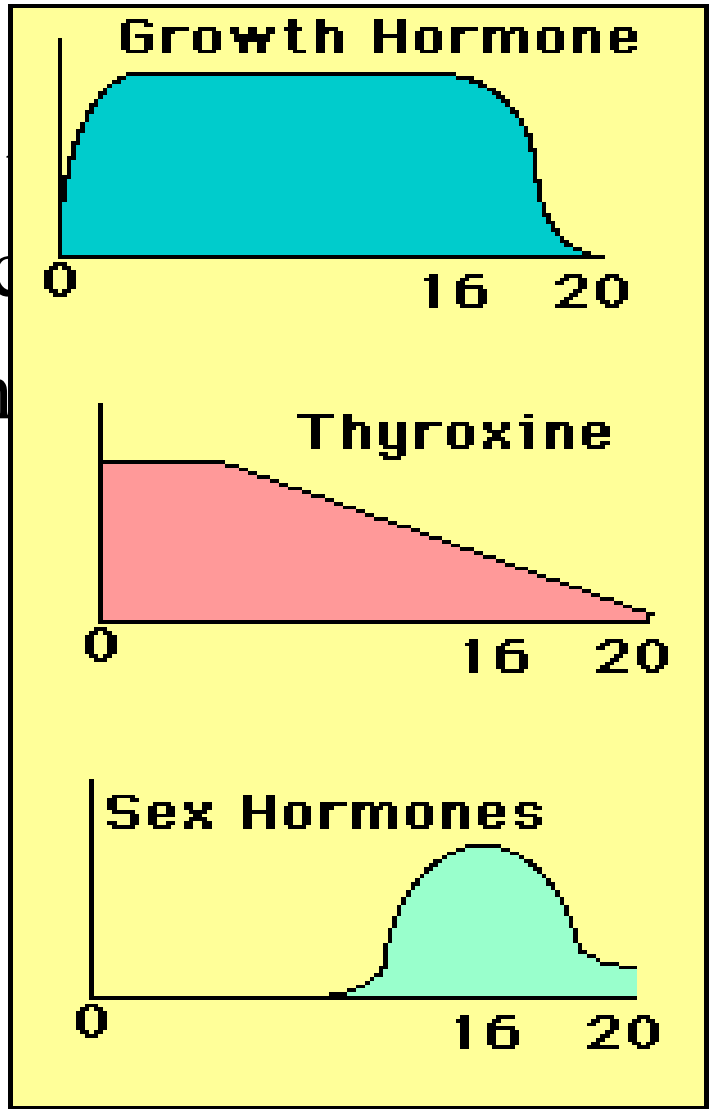
Growth

- With the life cycle the rate of growth is not even.
- Infancy has the highest rate decreasing until of spurt of growth caused by sexual maturity.



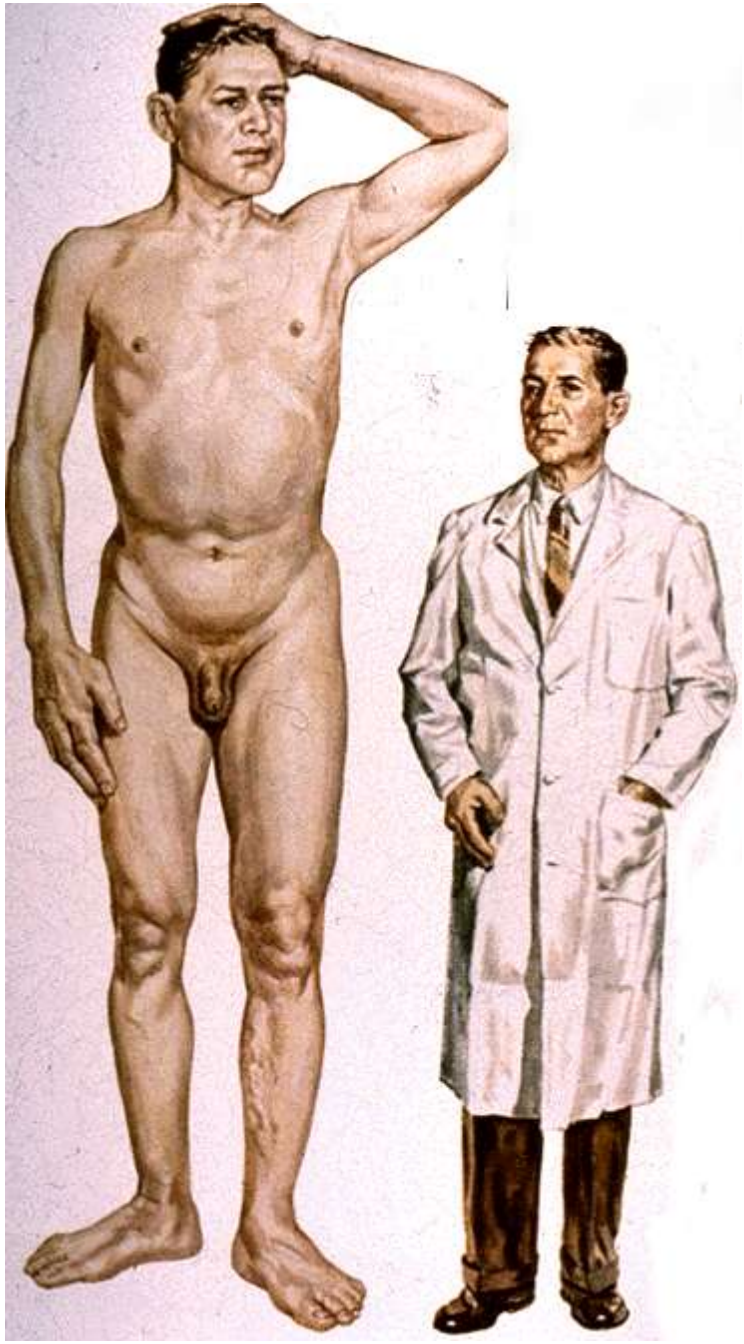
Growth

- Growth Rates differ according
  the time of the life cyc
- Growth hormone and Thyroxin
  are the most active.
- Sex hormones govern growth
  spurt at sexual maturity.



Growth Hormone Effects

- Protein Anabolic
- Increased plasma phosphorus
- Increase absorption of
  in gut
- Diabetogenic
- Growth Periods
- Dwarfism
- Giantism
- Acromegly



Giantism

- Excessive Production during childhood
- Different systems respond differently

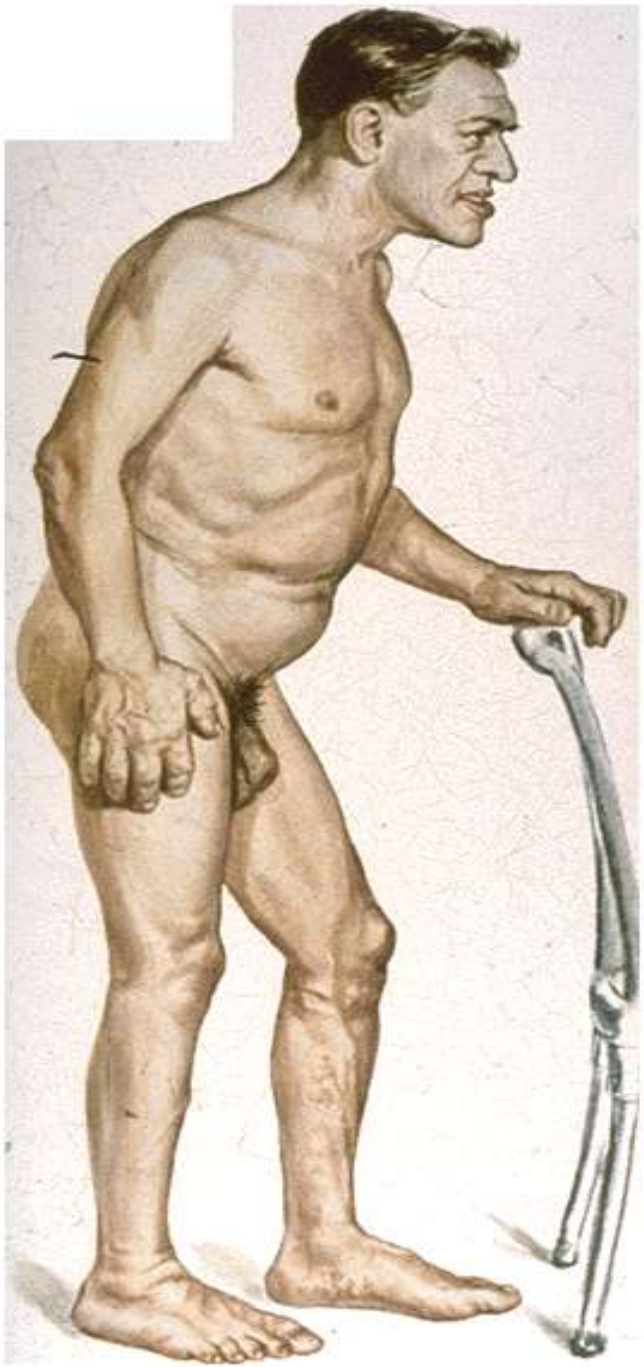
Acromegly

- Progression of untreated acromegly
- irregular bone growth continues

Prior

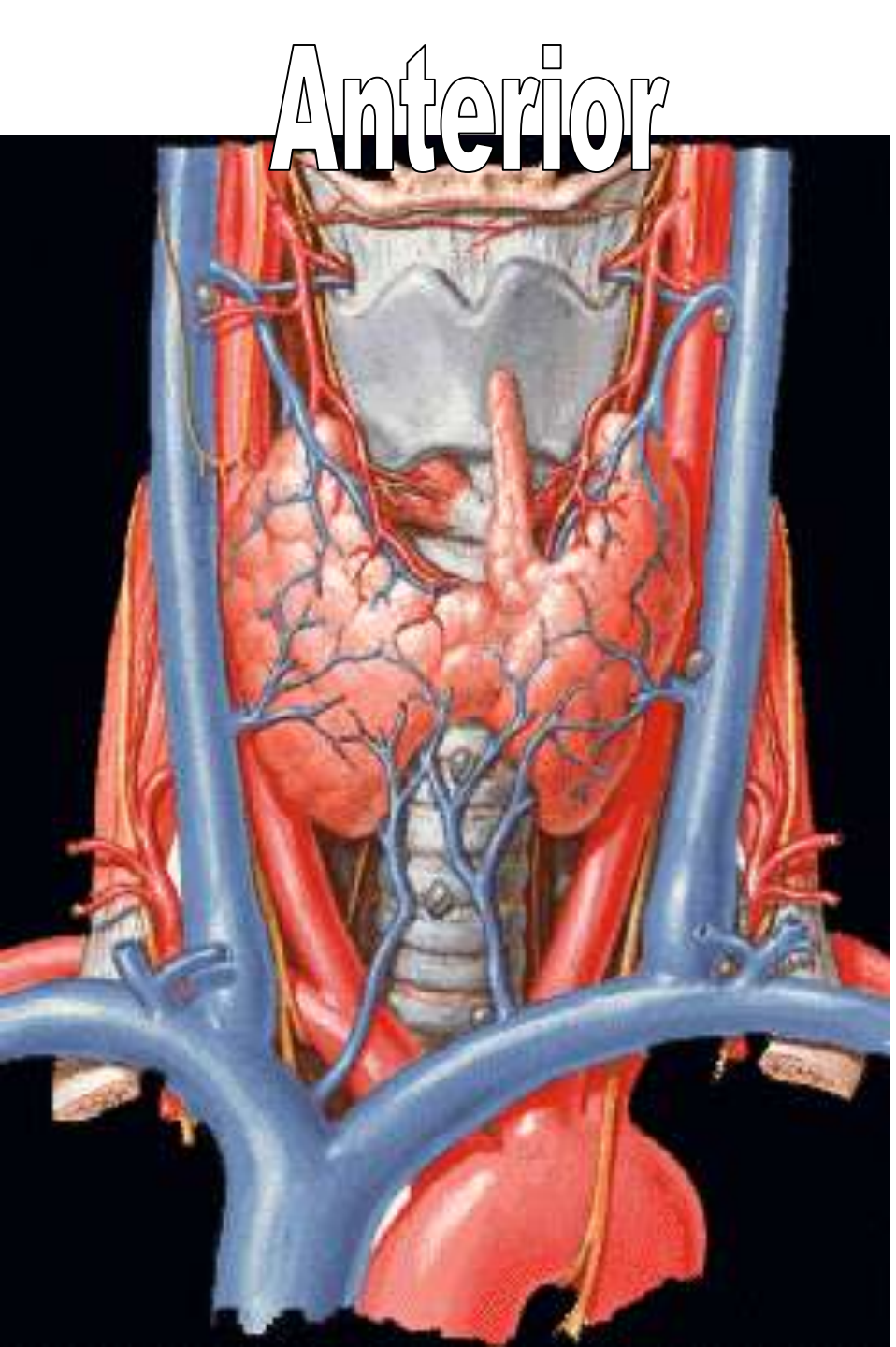
Early Onset

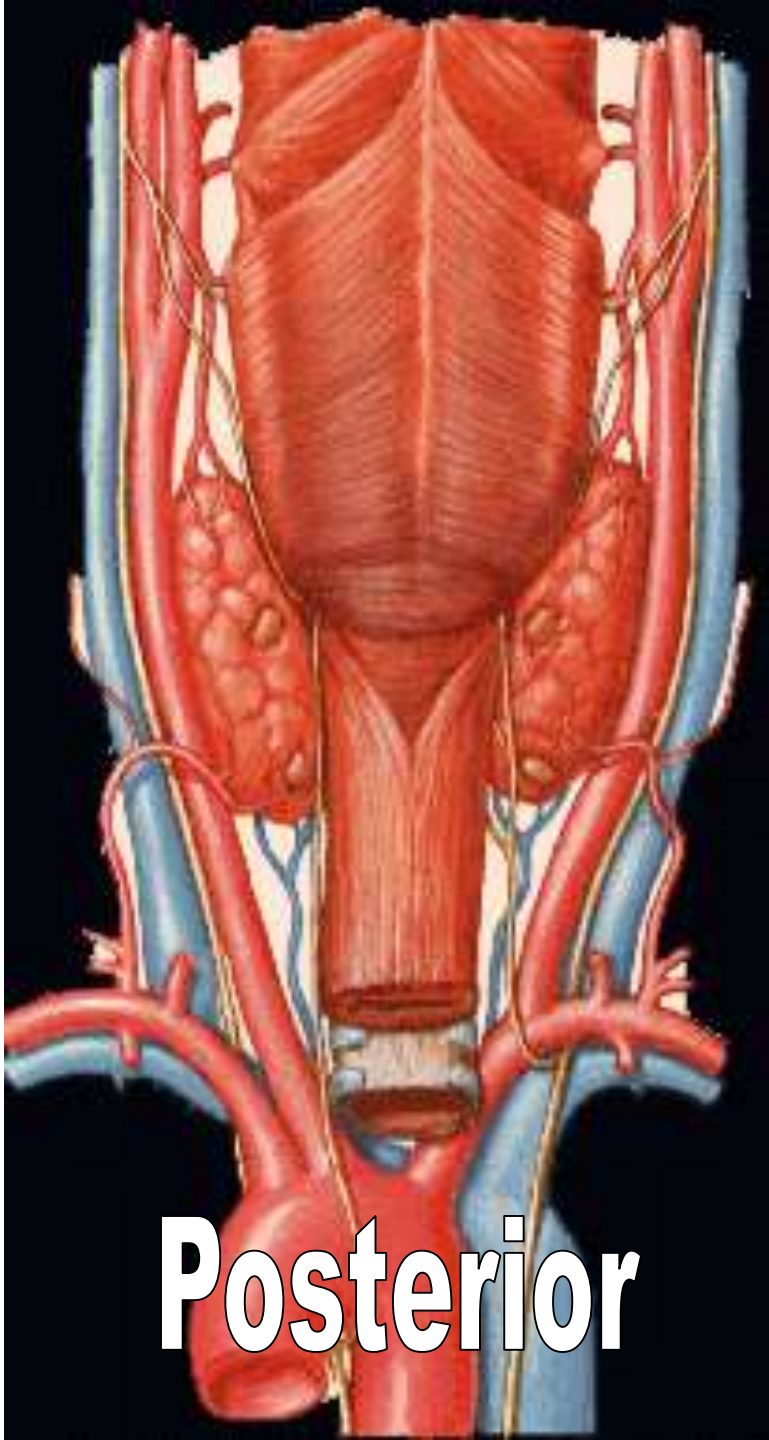
Full Development

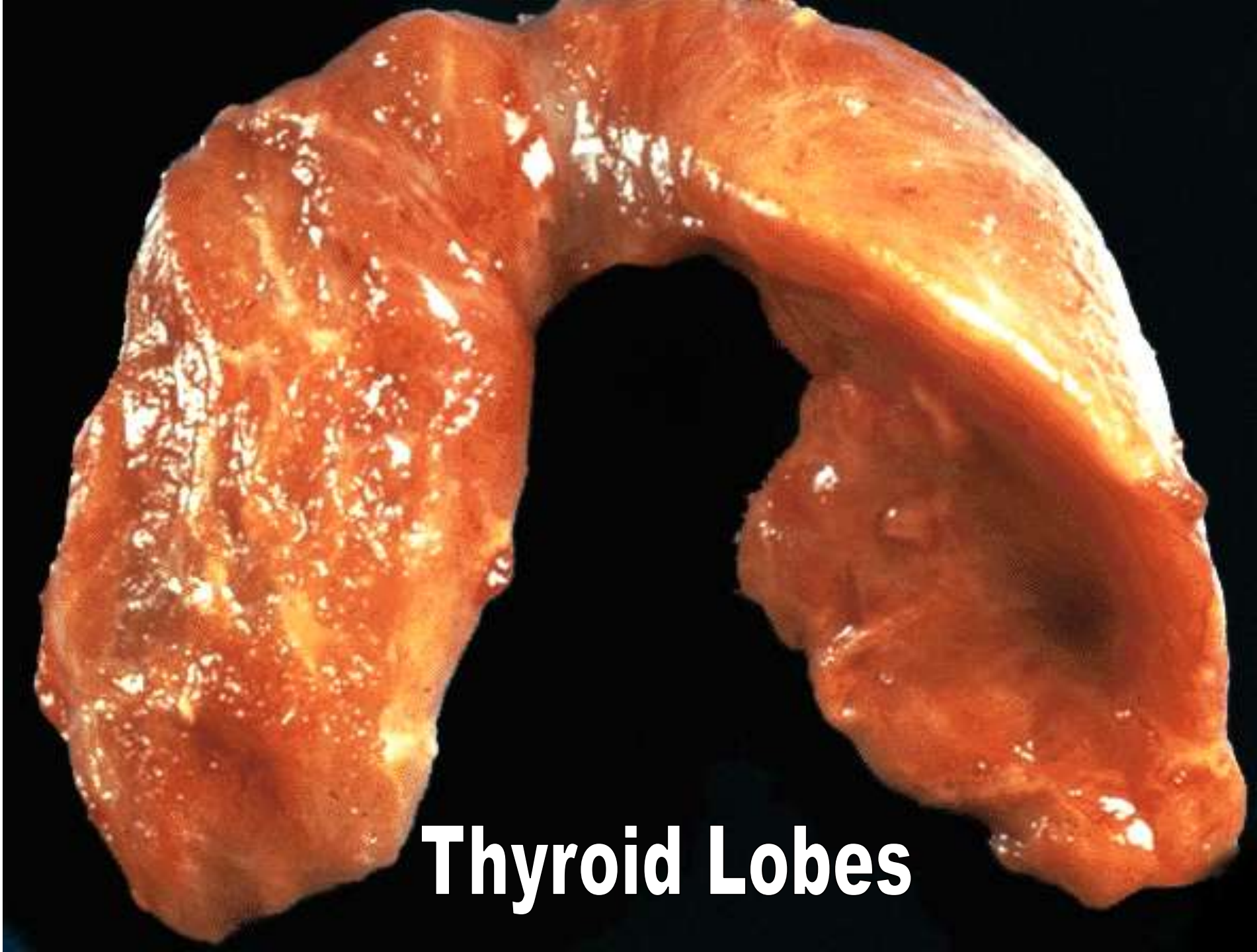


Acromegly

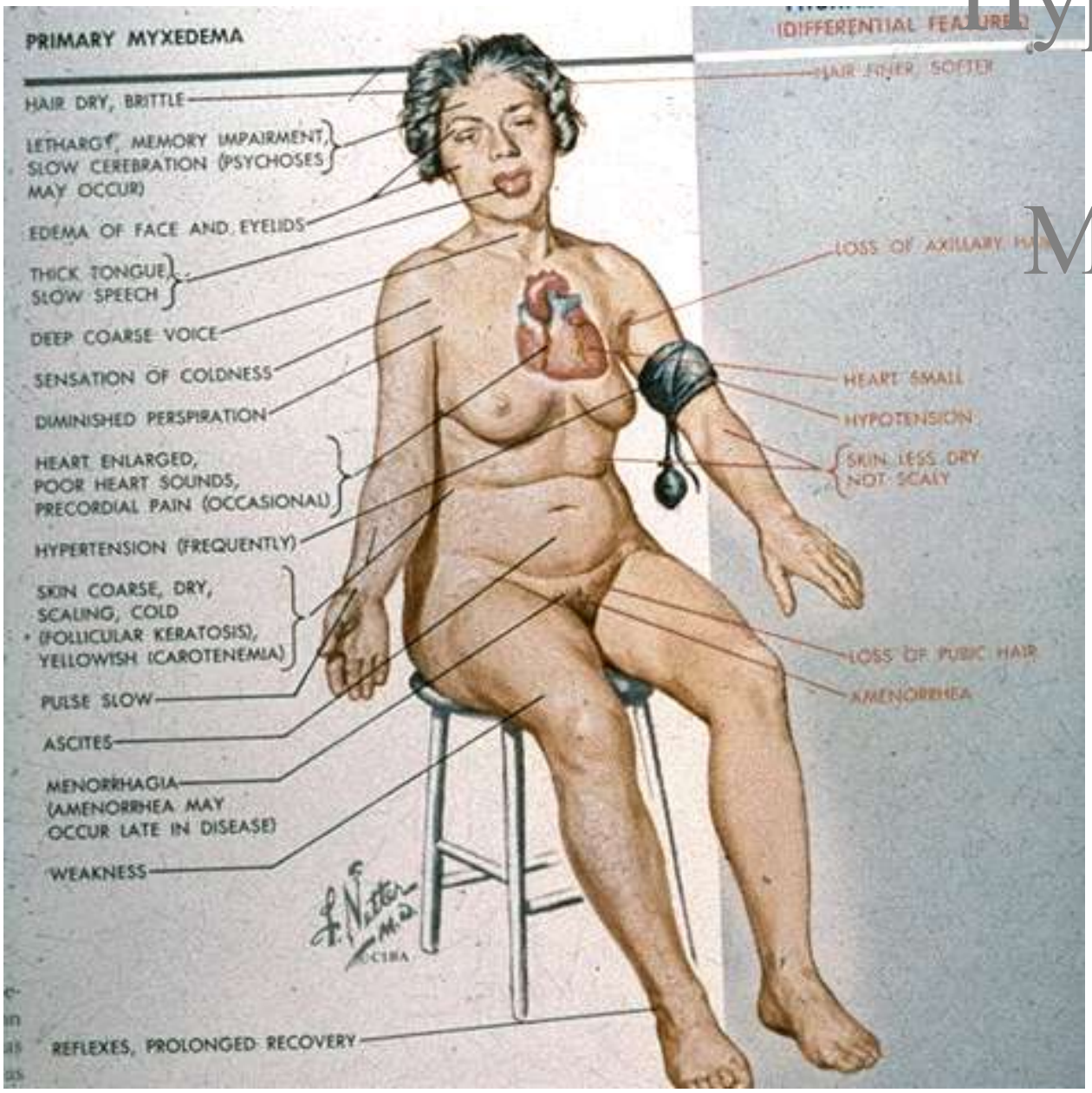
- Hands
- Feet
- Jaws


Anterior

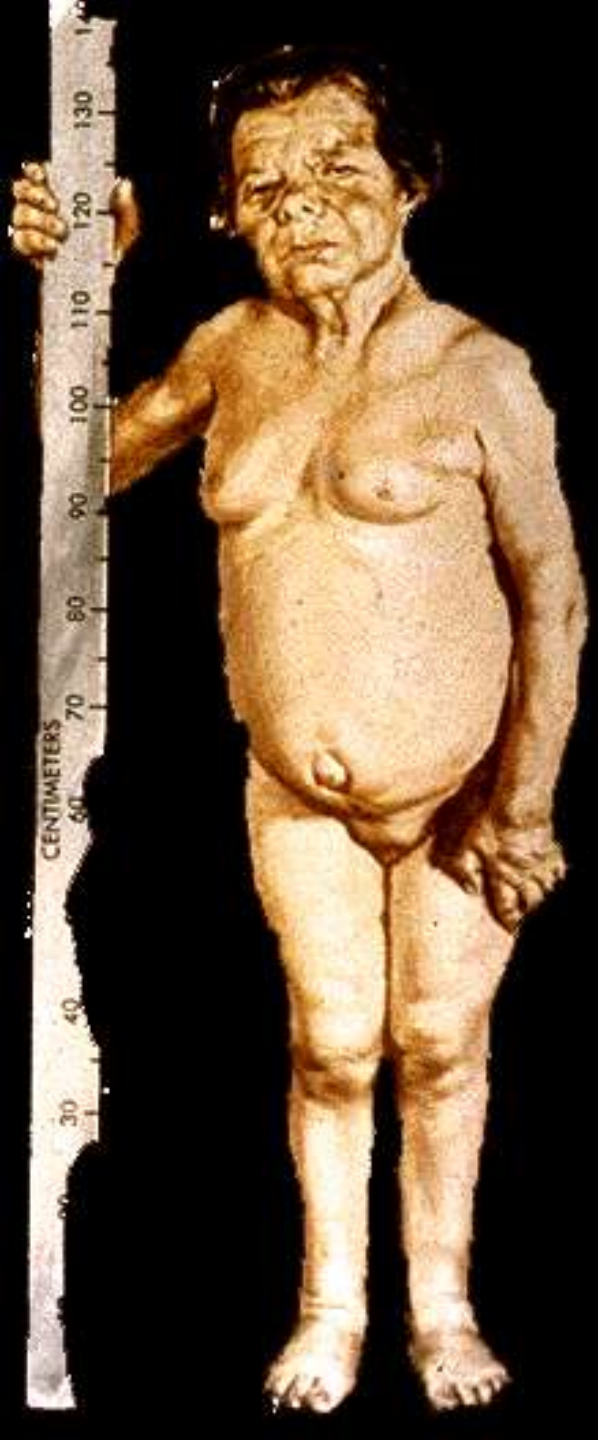

Posterior


Thyroid Lobes

Hypothyroidism Myxedema



Hypothyroidism

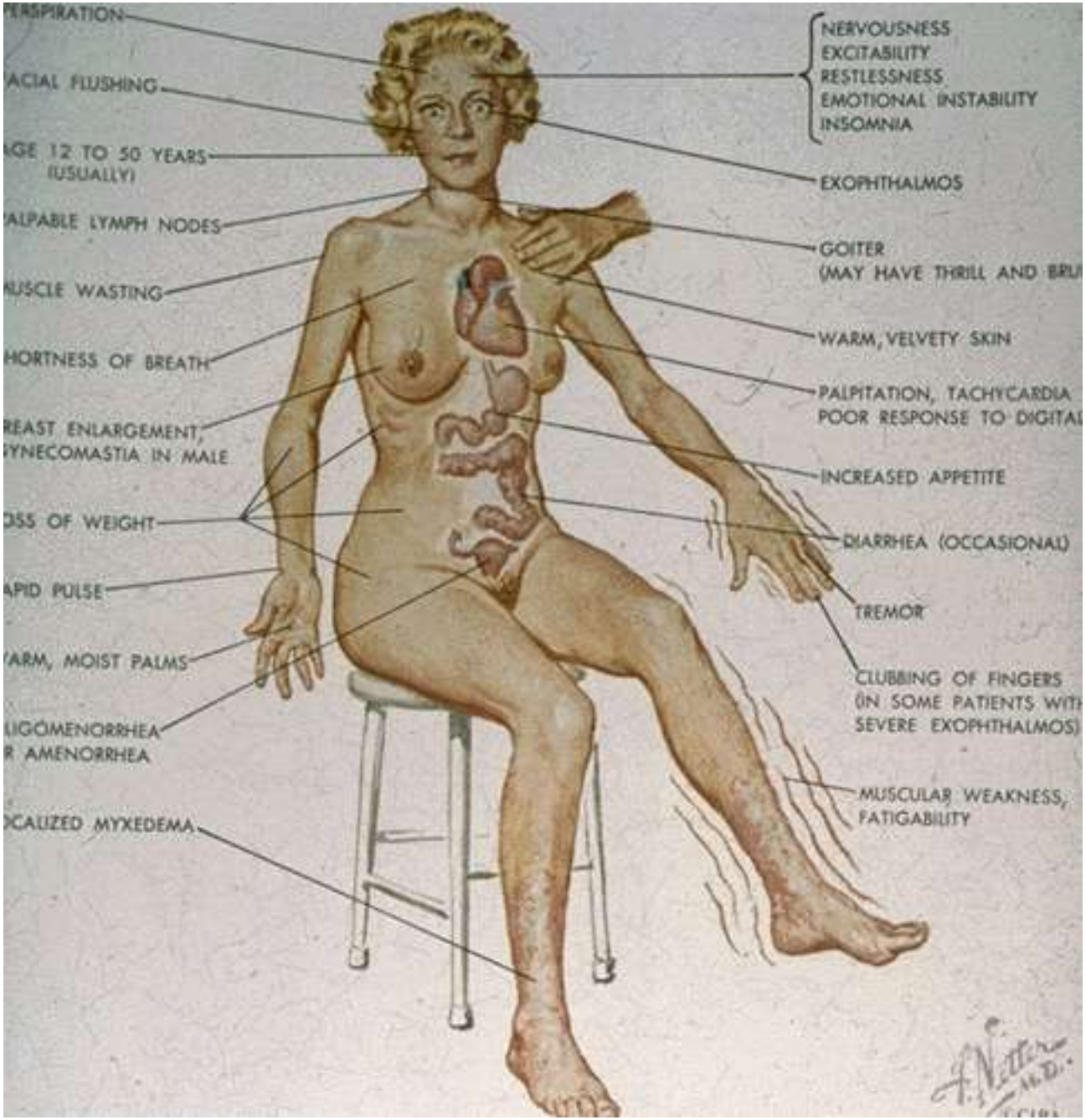


Cretinism

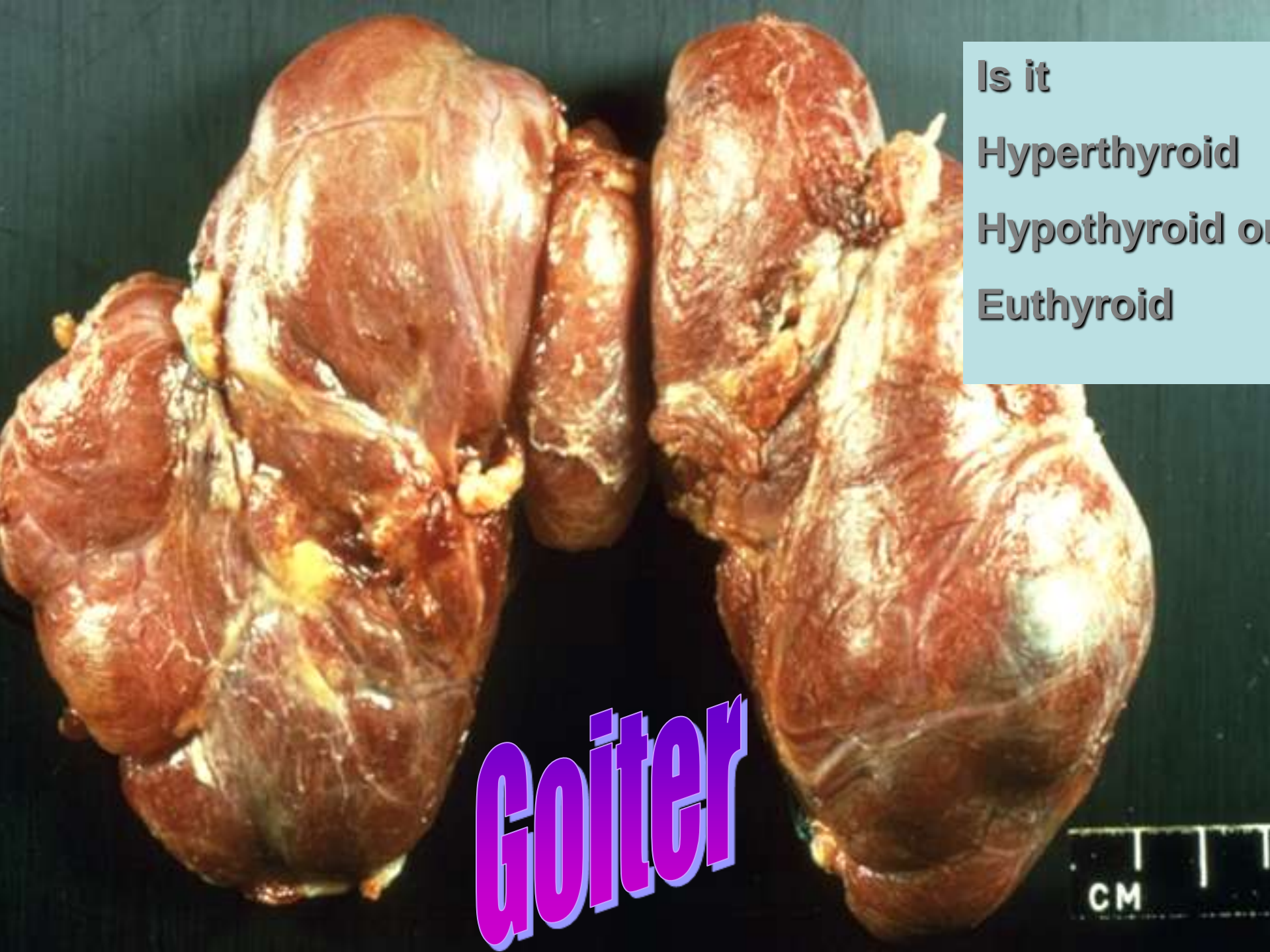
- Infancy onset
- Persists throughout life
- Severe mental retardation

Infantile Cretinism

- Megaglossal tongue
- Druppy eyelids
- Lack of genital development
- Severe mental retardation



Graves Disease


Is it
Hyperthyroid
Hypothyroid or
Euthyroid
Goiter
CM

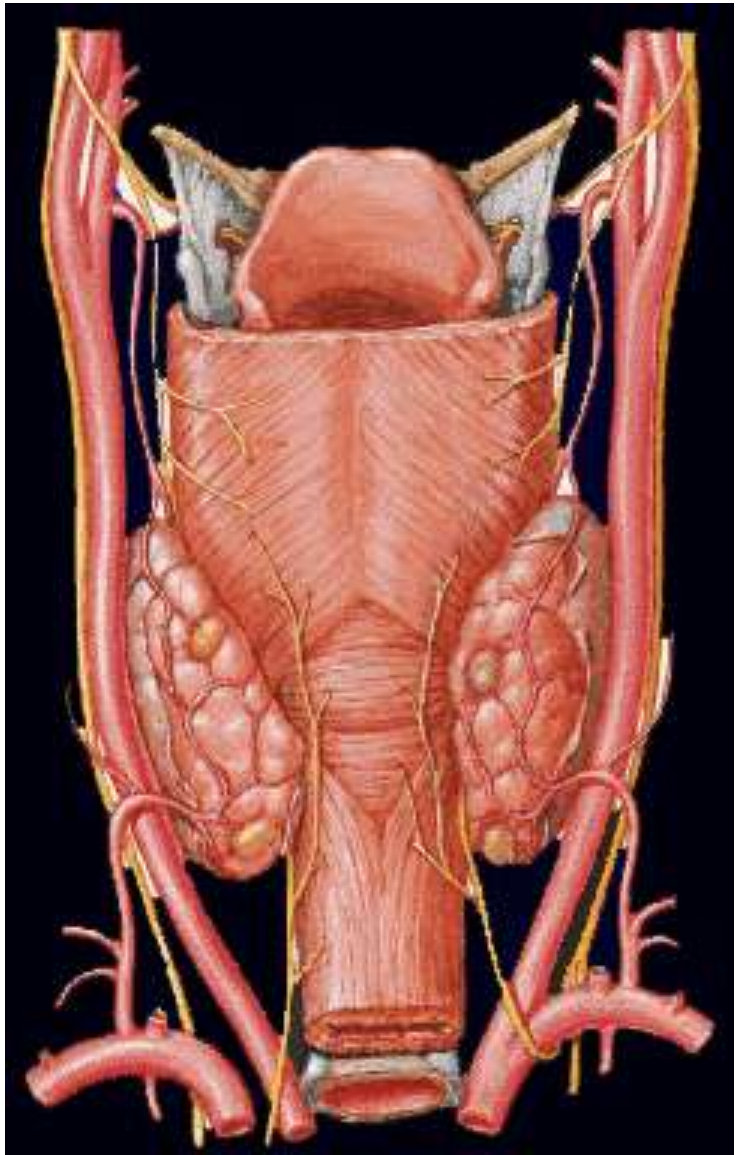
Hyperthroidism
Graves Disease

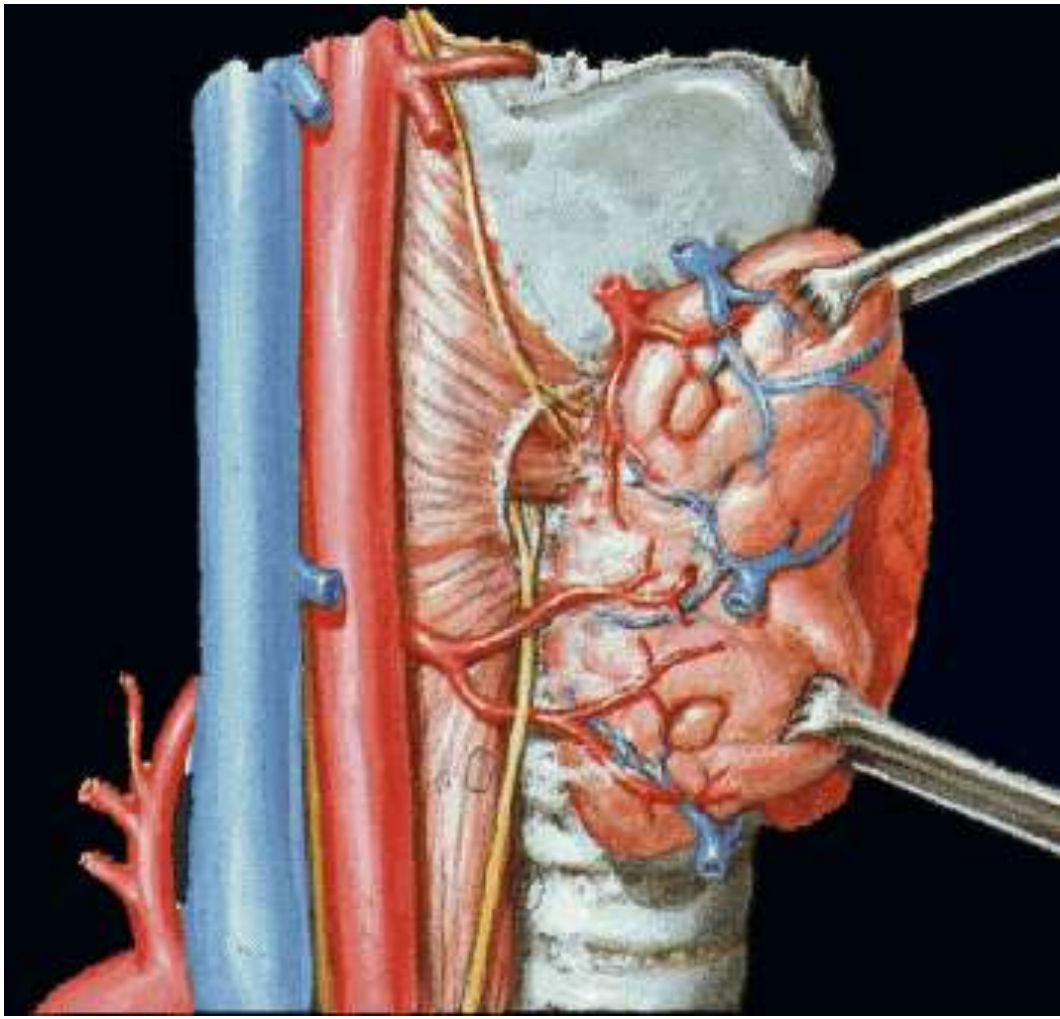
- Wasting of Temporalis and shoulder muscle
- Myxedema in limbs

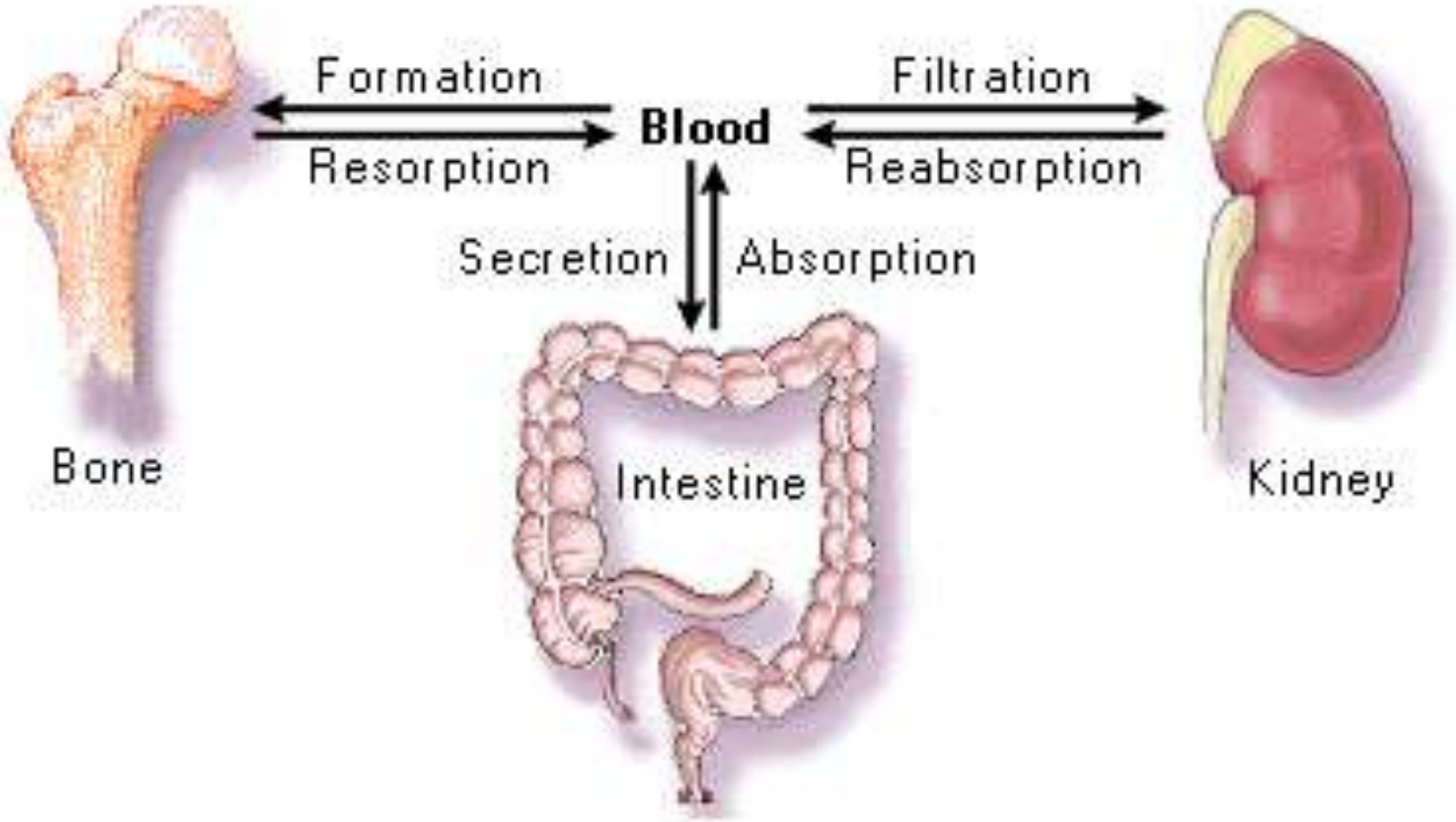
Exothalamia

- Fat accumulation behind eyes
- High TSH
- Patient previously had a thyroidectomy

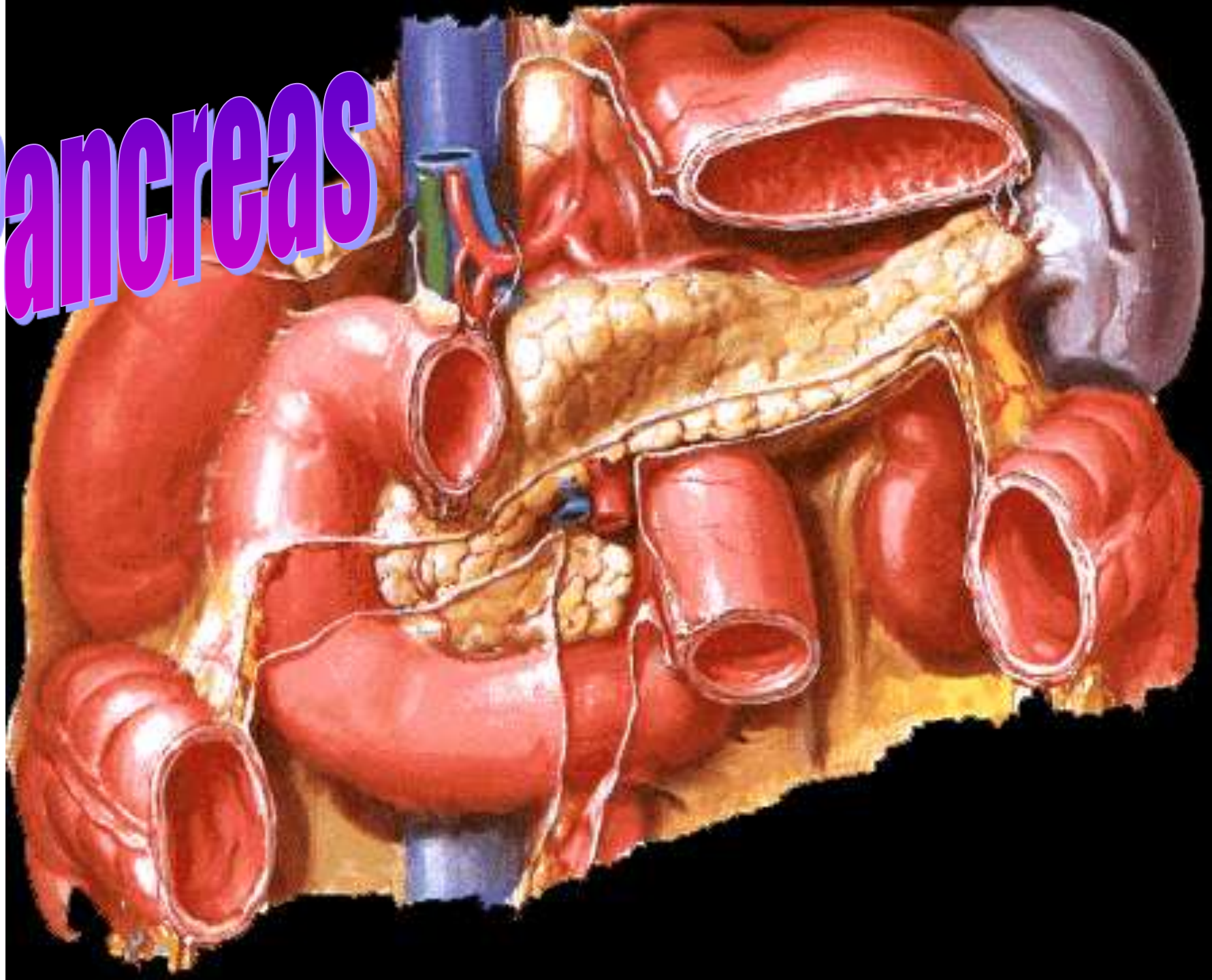
Parathyroid Glands



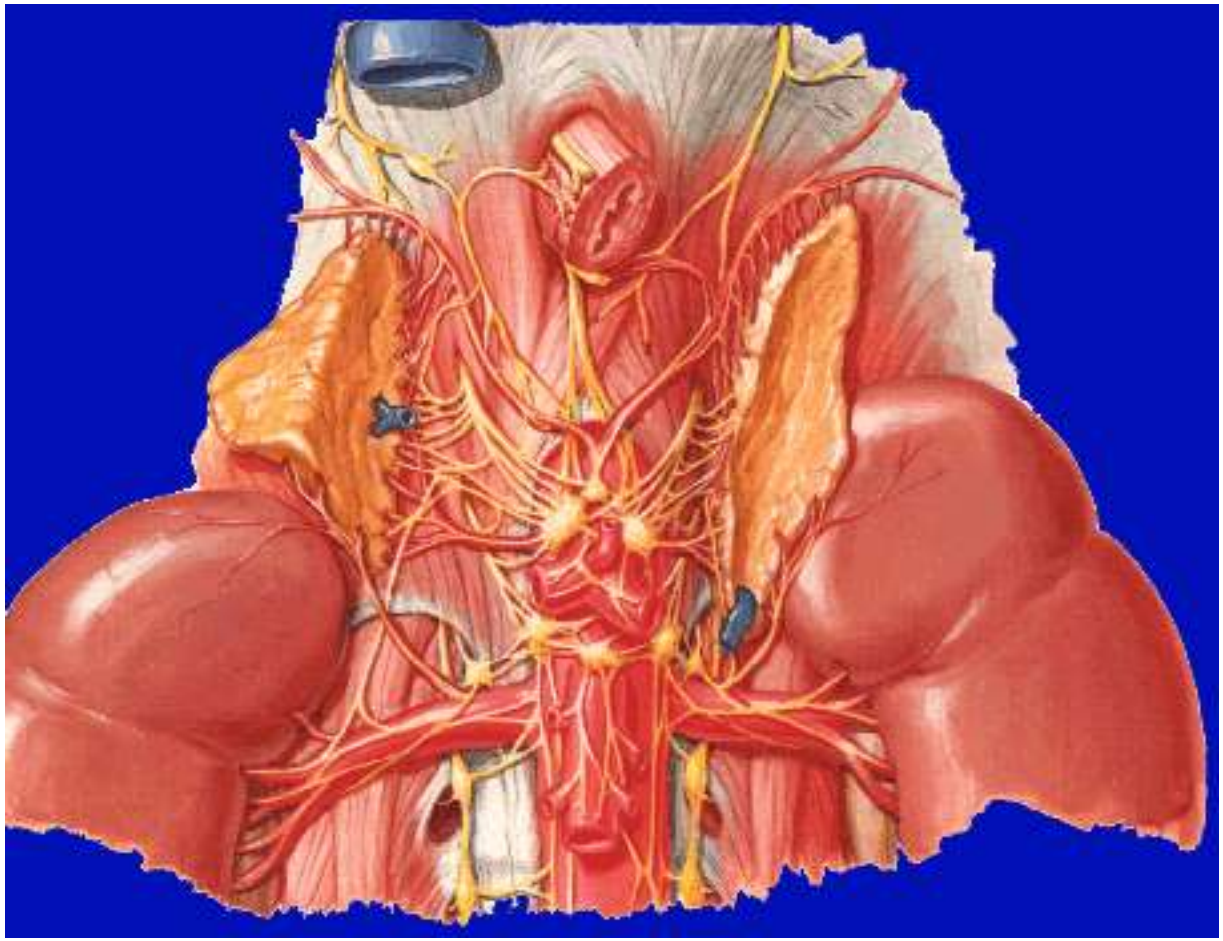



Formation
Resorption
Blood
Filtration
Reabsorption
Secretion
Absorption
Bone
Intestine
Kidney

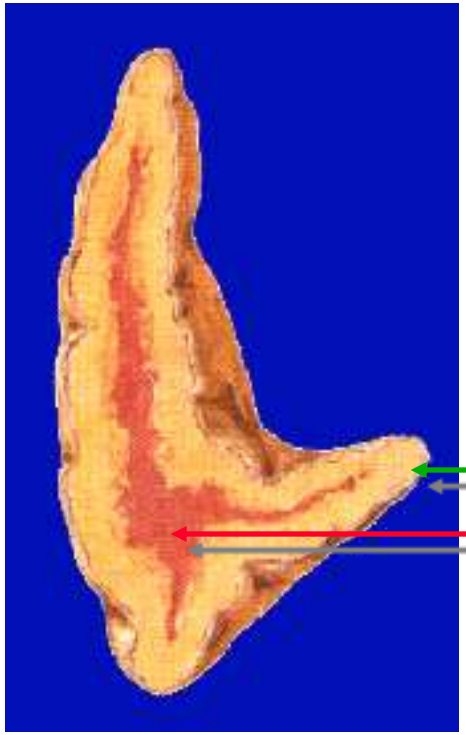
Pancreas



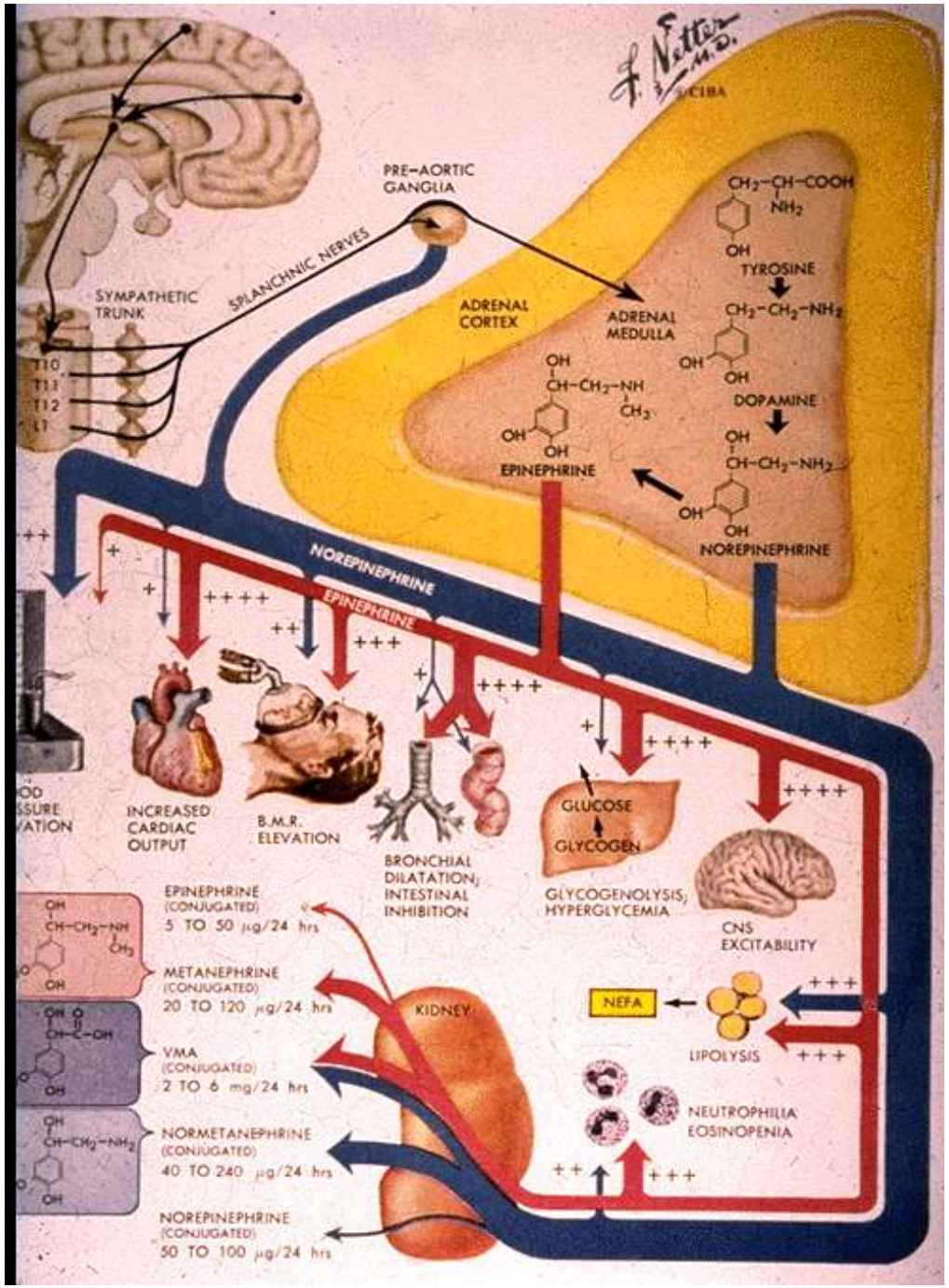
Adrenal Glands



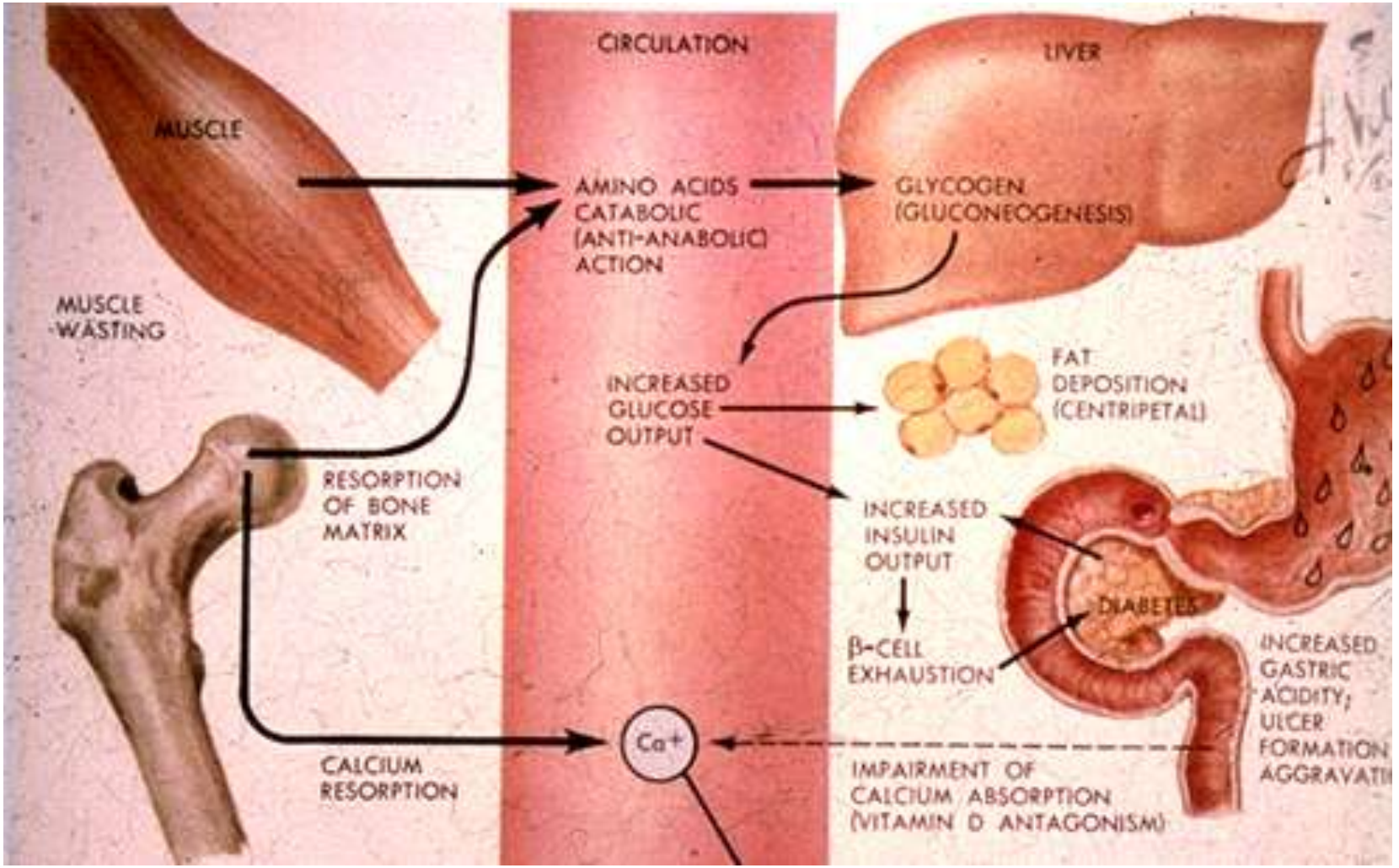
Adrenal Organization



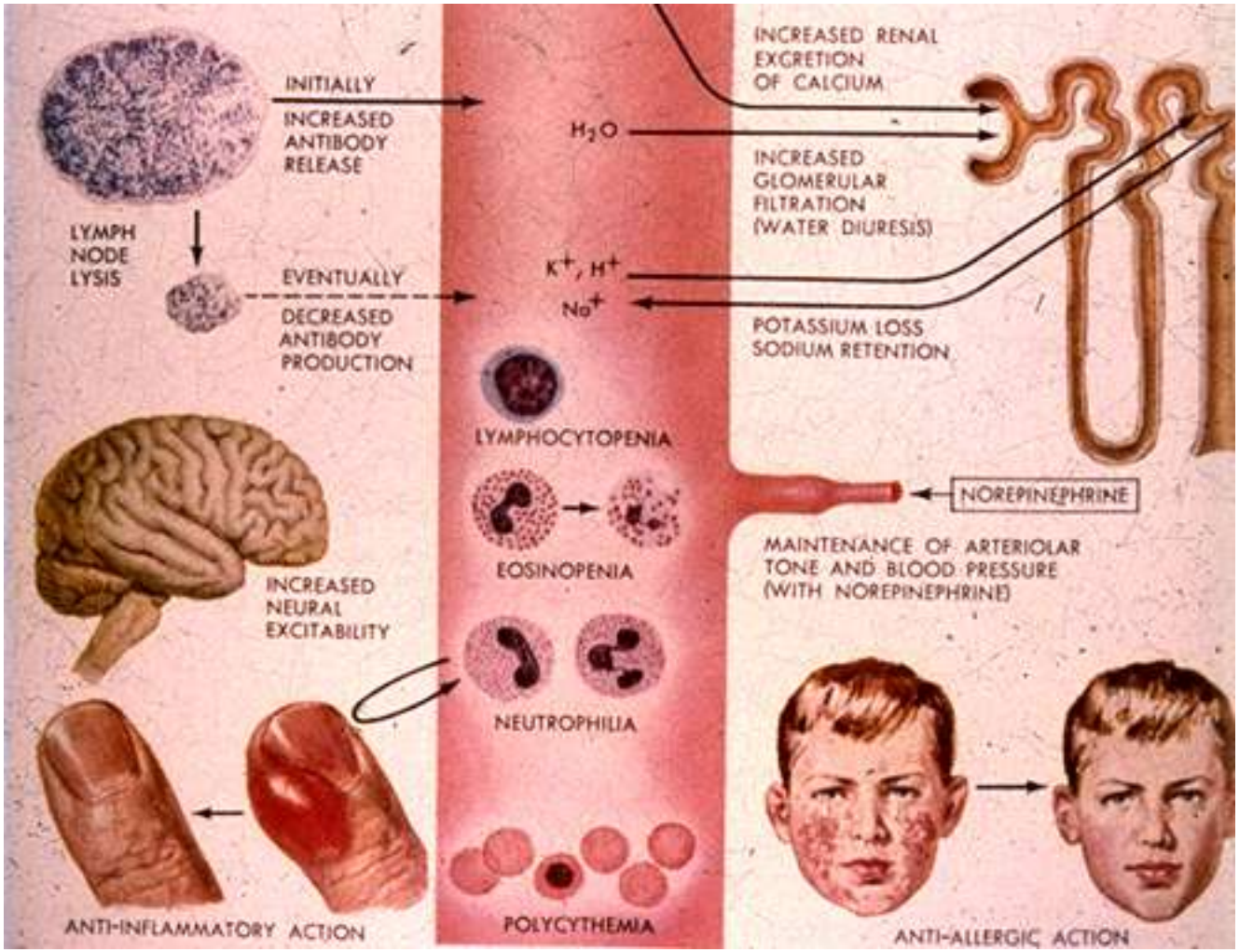
- Adrenal Medulla
- Adrenal Cortex
  - Zona Glomerulosa
  - Zona Faciculata
  - Zona Reticularis


F. Netter, M.D.
CIBA
PRE-AORTIC GANGLIA
SPLANCHNIC NERVES
SYMPATHETIC TRUNK
T10
T11
T12
L1
ADRENAL CORTEX
ADRENAL MEDULLA
TYROSINE
DOPAMINE
EPINEPHRINE
NOREPINEPHRINE
NOREPINEPHRINE
EPINEPHRINE
INCREASED CARDIAC OUTPUT
B.M.R. ELEVATION
BRONCHIAL DILATATION; INTESTINAL INHIBITION
GLUCOSE
GLYCOGEN
GLYCOGENOLYSIS; HYPERGLYCEMIA
CNS EXCITABILITY
NEFA
LIPOLYSIS
NEUTROPHILIA EOSINOPENIA
KIDNEY
EPINEPHRINE (CONJUGATED) 5 TO 50 µg/24 hrs
METANEPHRINE (CONJUGATED) 20 TO 120 µg/24 hrs
VMA (CONJUGATED) 2 TO 6 mg/24 hrs
NORMETANEPHRINE (CONJUGATED) 40 TO 240 µg/24 hrs
NOREPINEPHRINE (CONJUGATED) 50 TO 100 µg/24 hrs

Effects of Glucocorticoids

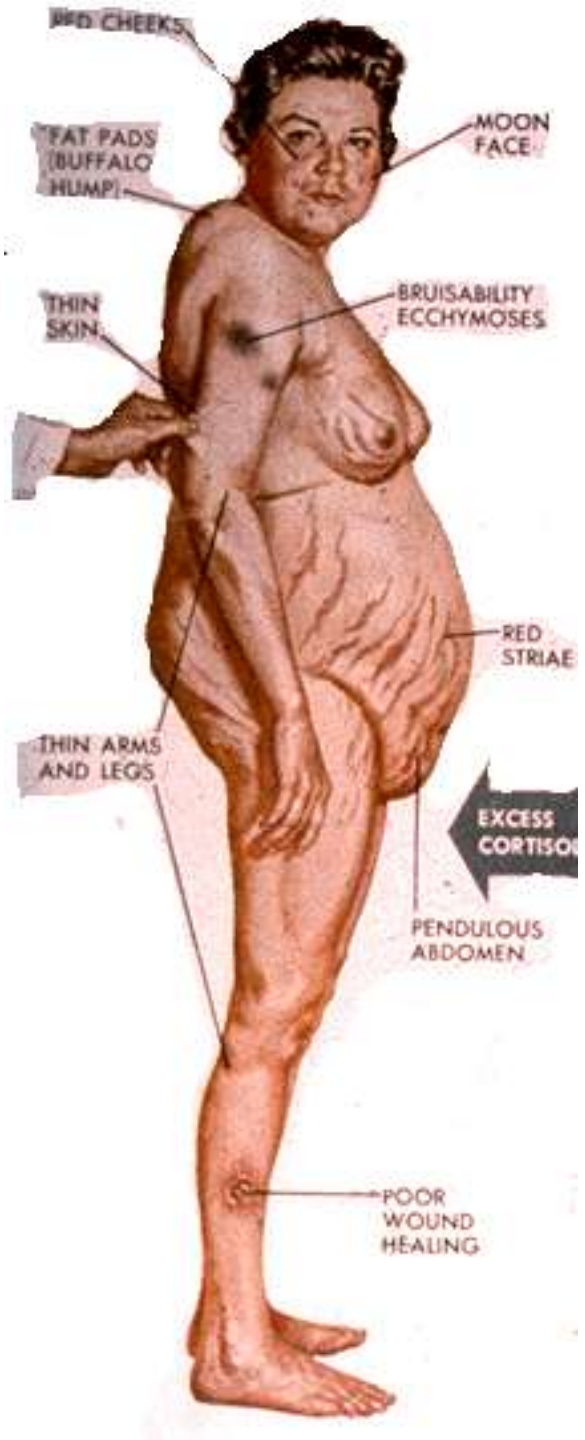


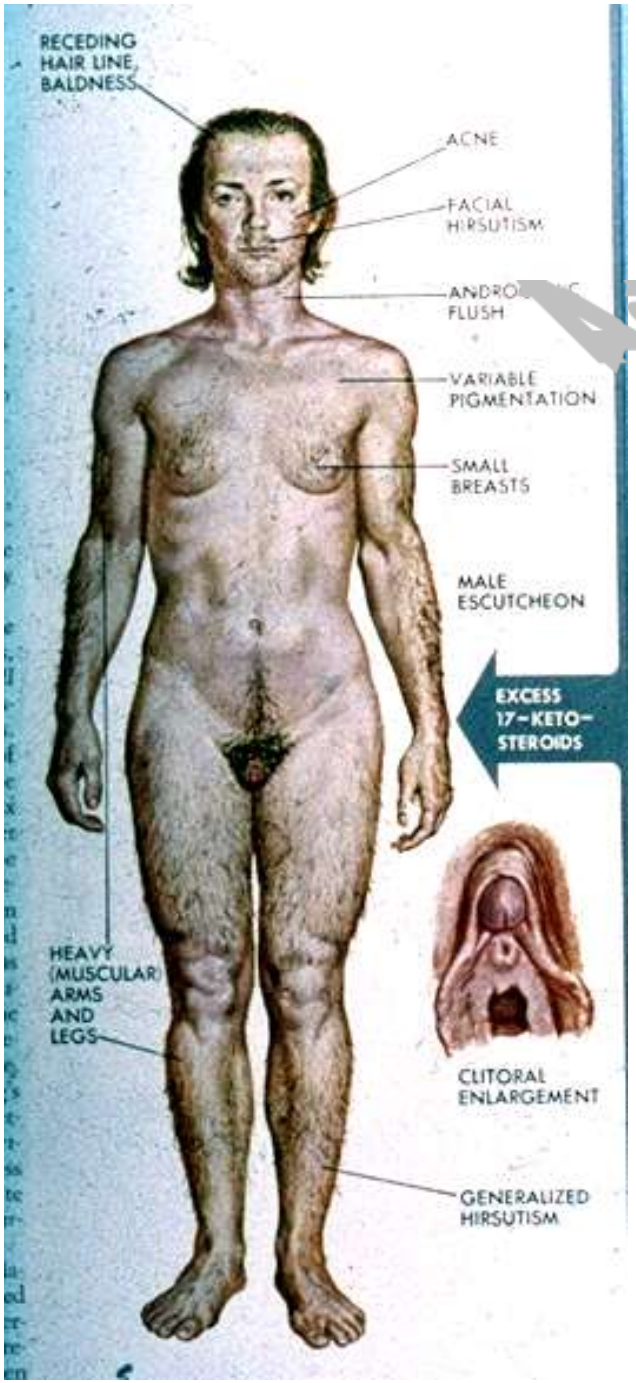
Effects of Glucocorticoids



Cushing's Syndrome

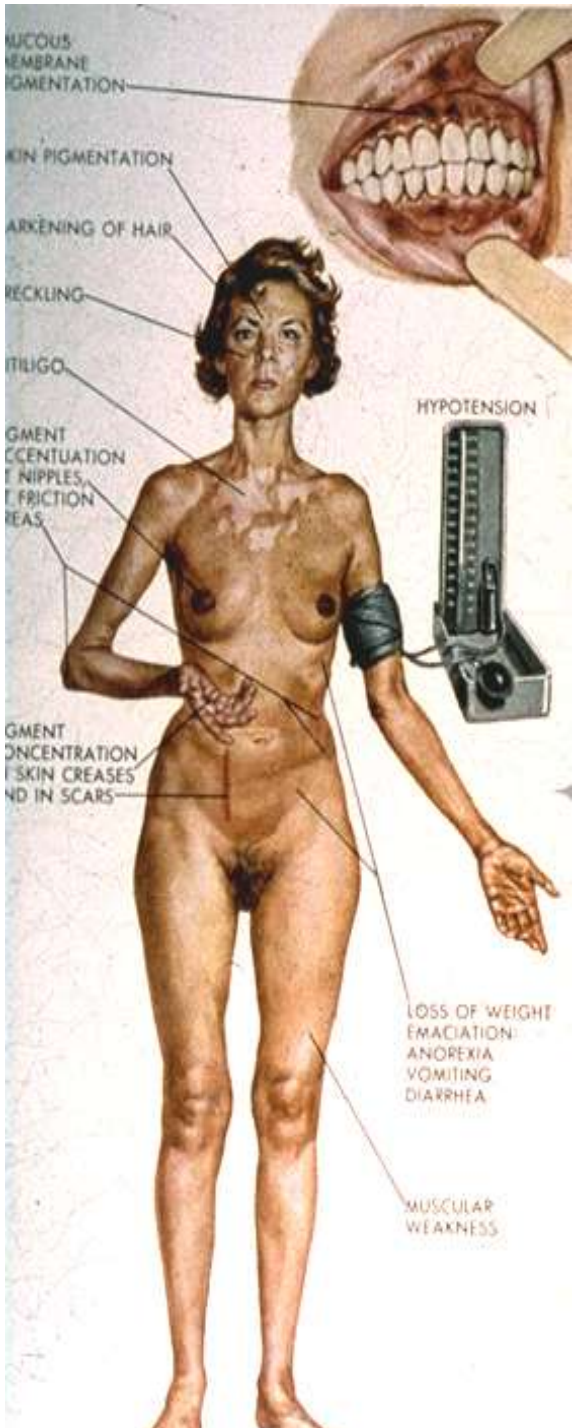
- Hyper-Adrenalism
- Primarily the Glucocorticoids





Adrenogenital Syndrome

- Adrenal tumor
- Pituitary Involvement???
- General Masculinization

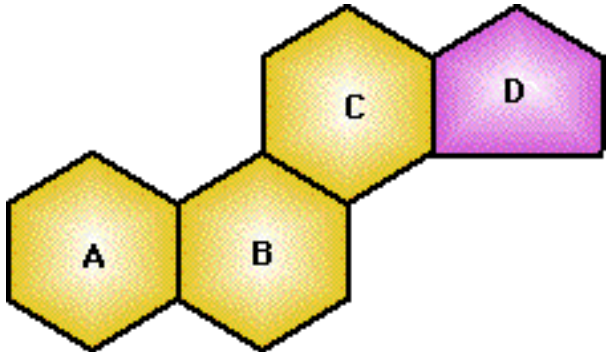


Addison's Disease

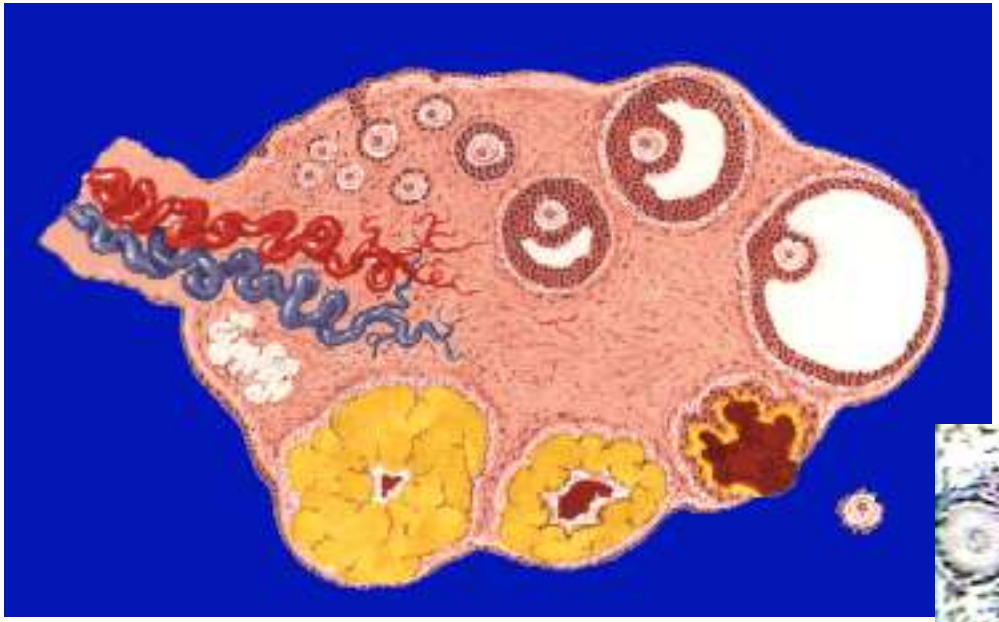
- Low adrenal activity
- Gonocorticoid appear normal
- Increased pigmentation due to increased ACTH

Sex Hormones

- Classic Sex Hormones: Gonad and Adrenal
- Estrogen
- Progesterone
- Dihydrotestosterone
- Testosterone



Ovary



- Follicles
- Estrogen
- Progesterone

Testes

- Mature Testis
- Semeniferous Tubules, Interstitial cells
- Testosterone
- Estrogen
- Inhibin