BIOLOGY DEPT. THIRD STAGE

LEC 5

ENDOCRINE GLANDS:

SECRETION AND ACTION OF HORMONES

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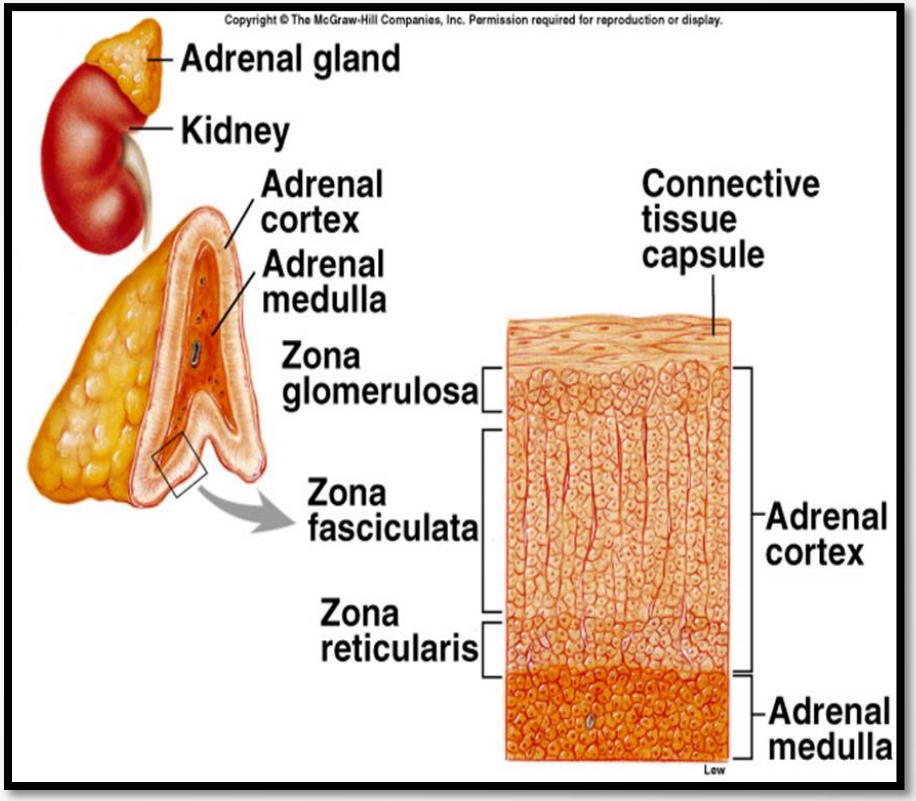
2 - Adrenal Glands

- **Paired organs that cap the kidneys.**
- **Each gland consists of an outer cortex and inner medulla.**
- **Adrenal medulla:**
  - **Derived from embryonic neural crest ectoderm (same tissue that produces the sympathetic ganglia).**
  - **Synthesizes and secretes:**
  - **Catecholamines (mainly Epi but some NE).**
    - **Adrenal cortex:**
      - **Does not receive neural innervation.**
      - **Must be stimulated hormonally (ACTH).**
    - **Consists of 3 zones:**
      - **Zona glomerulosa.**
      - **Zona fasciculata.**
      - **Zona reticularis.**
    - **Secretes corticosteroids.**



Functions of the Adrenal gland

Functions of the Adrenal Cortex

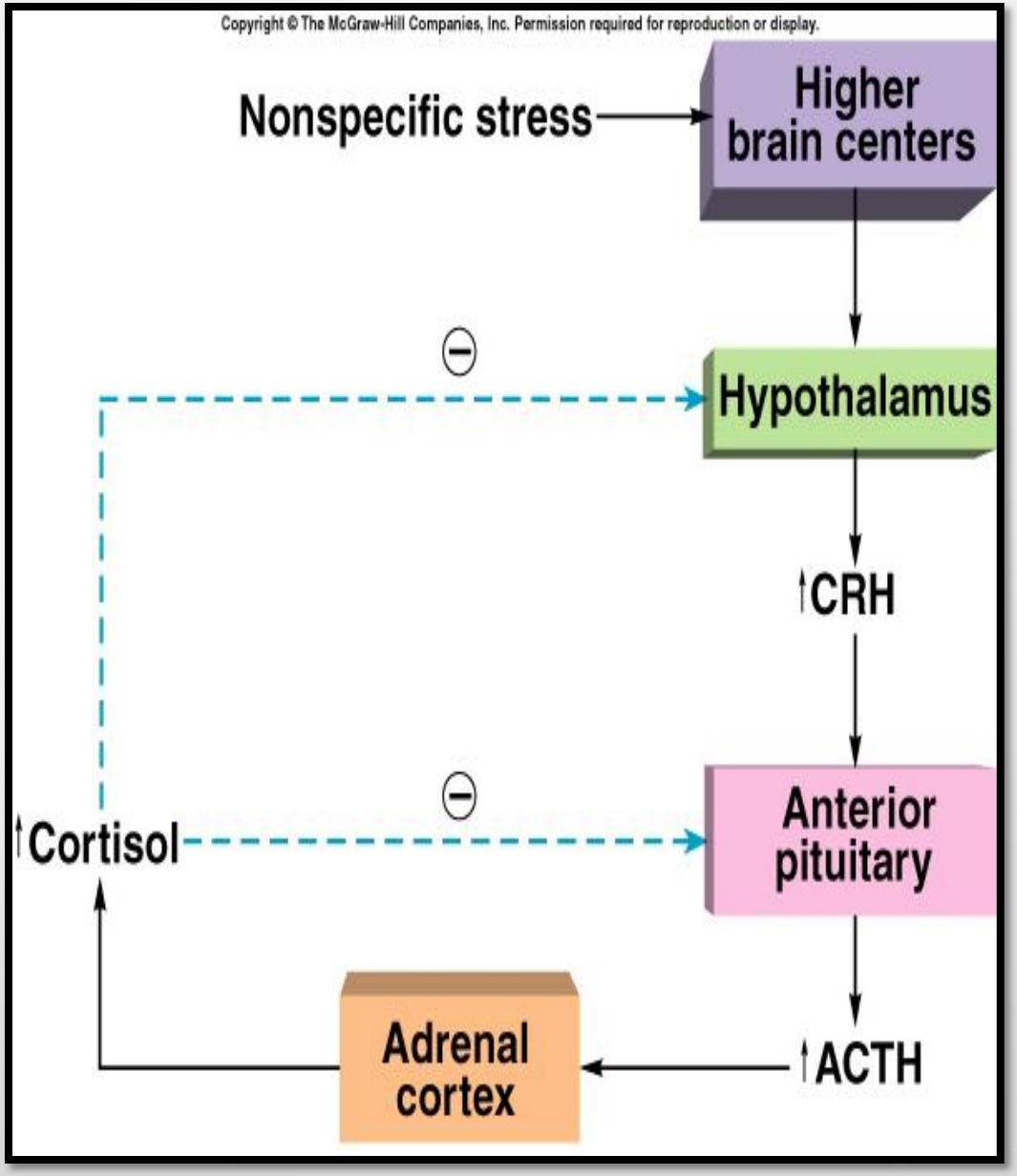
- **Zona glomerulosa:**
  - **Mineralcorticoids (aldosterone):**
    - **Stimulate kidneys to reabsorb Na^+ and secrete K^+.**
- **Zona fasciculata:**
  - **Glucocorticoids (cortisol):**
    - **Inhibit glucose utilization and stimulate gluconeogenesis.**
- **Zona reticularis (DHEA):**
  - **Sex steroids:**
  - **Supplement sex steroids.**

Functions of the Adrenal Medulla

- **Innervated by preganglionic sympathetic axons.**
  - **Increase respiratory rate.**
  - **Increase HR and cardiac output.**
  - **Vasoconstrict blood vessels, thus increasing venous return.**
  - **Stimulate glycogenolysis.**
  - **Stimulate lipolysis.**

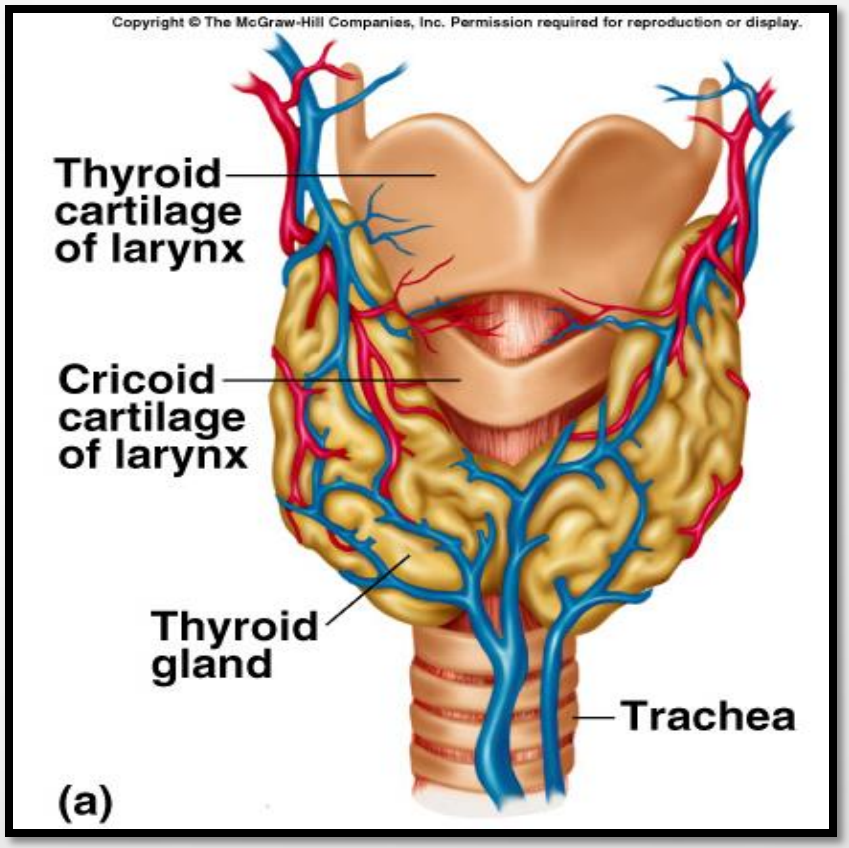
Stress and the Adrenal Gland

- **Non-specific response to stress produces the general adaptation syndrome (GAS).**
- **Alarm phase:**
  - **Adrenal glands activated.**
- **Stage of resistance:**
  - **Stage of readjustment.**
- **Stage of exhaustion:**
  - **Sickness and/or death if readjustment is not complete.**



3 - Thyroid Hormones

- Thyroid gland is located just below the larynx.
- Thyroid is the largest of the pure endocrine glands.
- Follicular cells secrete thyroxine.
- Parafollicular cells secrete calcitonin.



Production of Thyroid Hormones

- T_3 and T_4 produced.
- TSH stimulates pinocytosis into the follicular cell.
  - Enzymes hydrolyze T_3 and T_4 from thyroglobulin.
- Attached to TBG and released into blood.

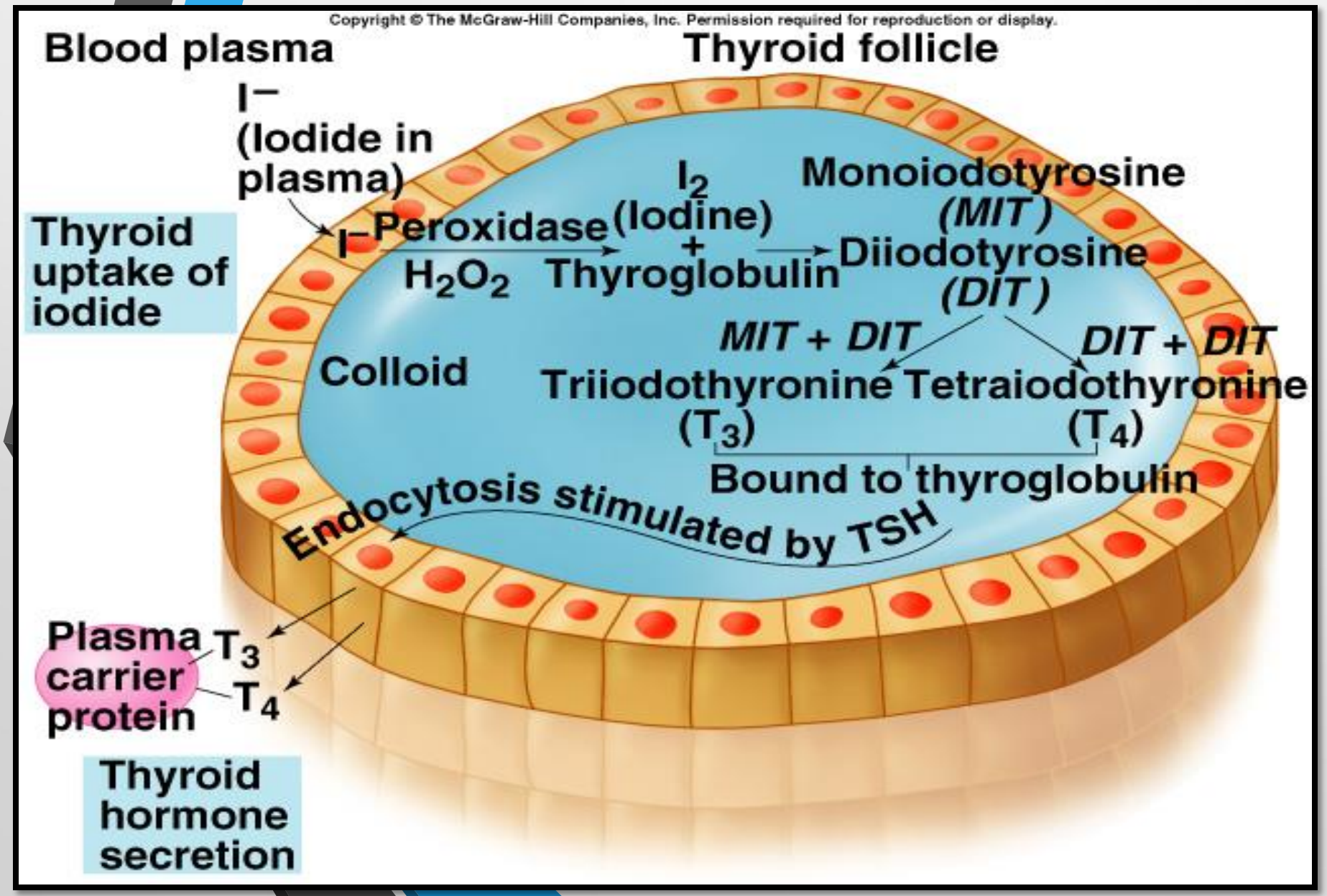
3 - Thyroid Hormones

Production of Thyroid Hormones

- **Iodide (I^-) actively transported into the follicle and secreted into the colloid.**
- **Oxidized to iodine (I^o).**
- **Iodine attached to tyrosine within thyroglobulin chain.**
  - **Attachment of 1 iodine produces monoiodotyrosine (MIT).**
  - **Attachment of 2 iodines produces diiodotyrosine (DIT).**

MIT and DIT or 2 DIT molecules coupled together.

Production of Thyroid Hormones



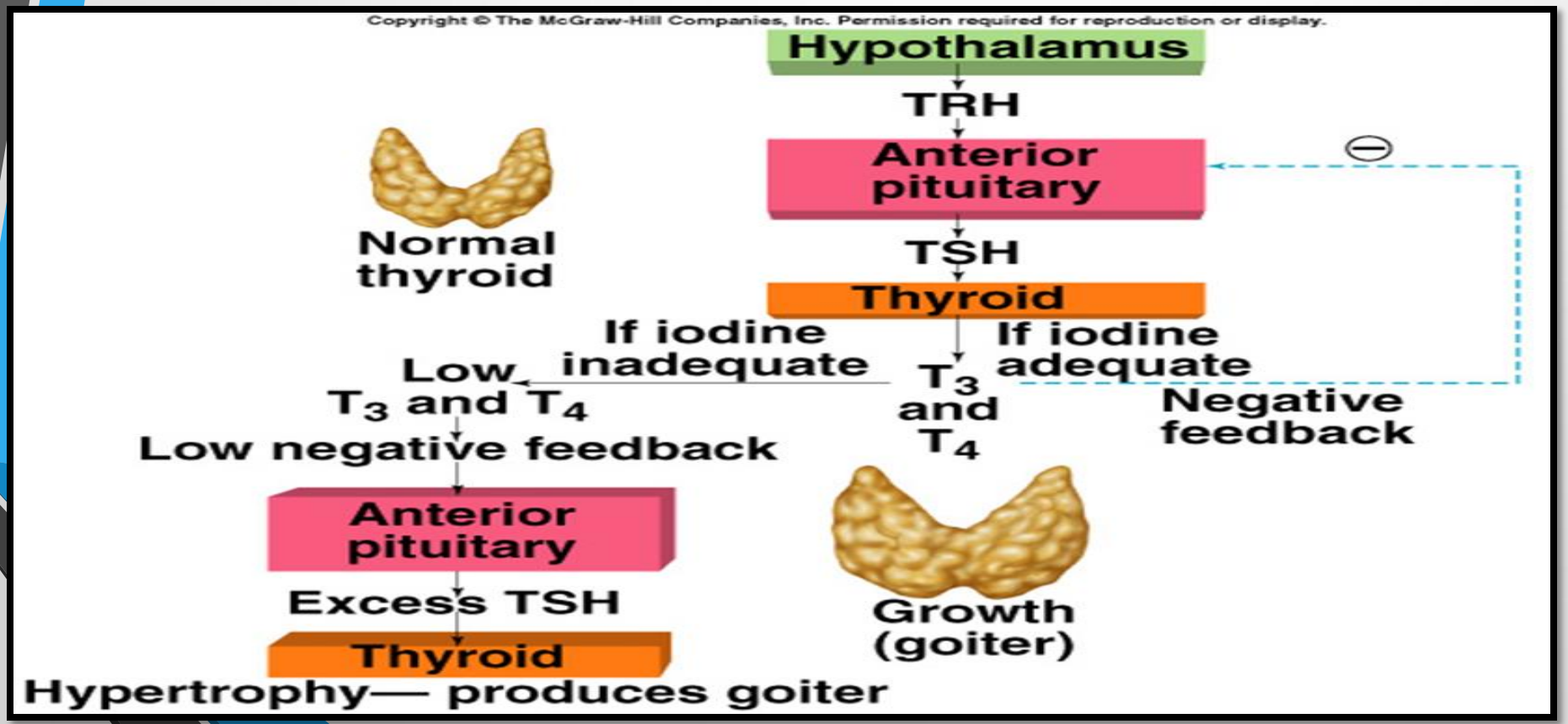
Action of T3

- Stimulates protein synthesis.
- Promotes maturation of nervous system.
- Stimulates rate of cellular respiration by:
  - Production of uncoupling proteins.
  - Increase active transport by Na^+/K^+ pumps.
  - Lower cellular [ATP].
- Increases metabolic heat.
- Increases metabolic rate.
  - Stimulates increased consumption of glucose, fatty acids and other molecules.

Diseases of the Thyroid Gland

1 - Iodine-deficiency (endemic) goiter:

- **Abnormal growth of the thyroid gland.**
  - **In the absence of sufficient iodine, cannot produce adequate amounts of T_4 and T_3.**
  - **Lack of negative feedback inhibition. Stimulates TSH, which causes abnormal growth.**



Diseases of the Thyroid Gland

- **Iodine-deficiency (endemic) goiter**
- **Adult myxedema:**
  - **Accumulation of mucoproteins and fluid in subcutaneous tissue.**
- **Symptoms:**
  - **Decreased metabolic rate. Weight gain. Decreased ability to adapt to cold. Lethargy.**

2 - Grave's disease:

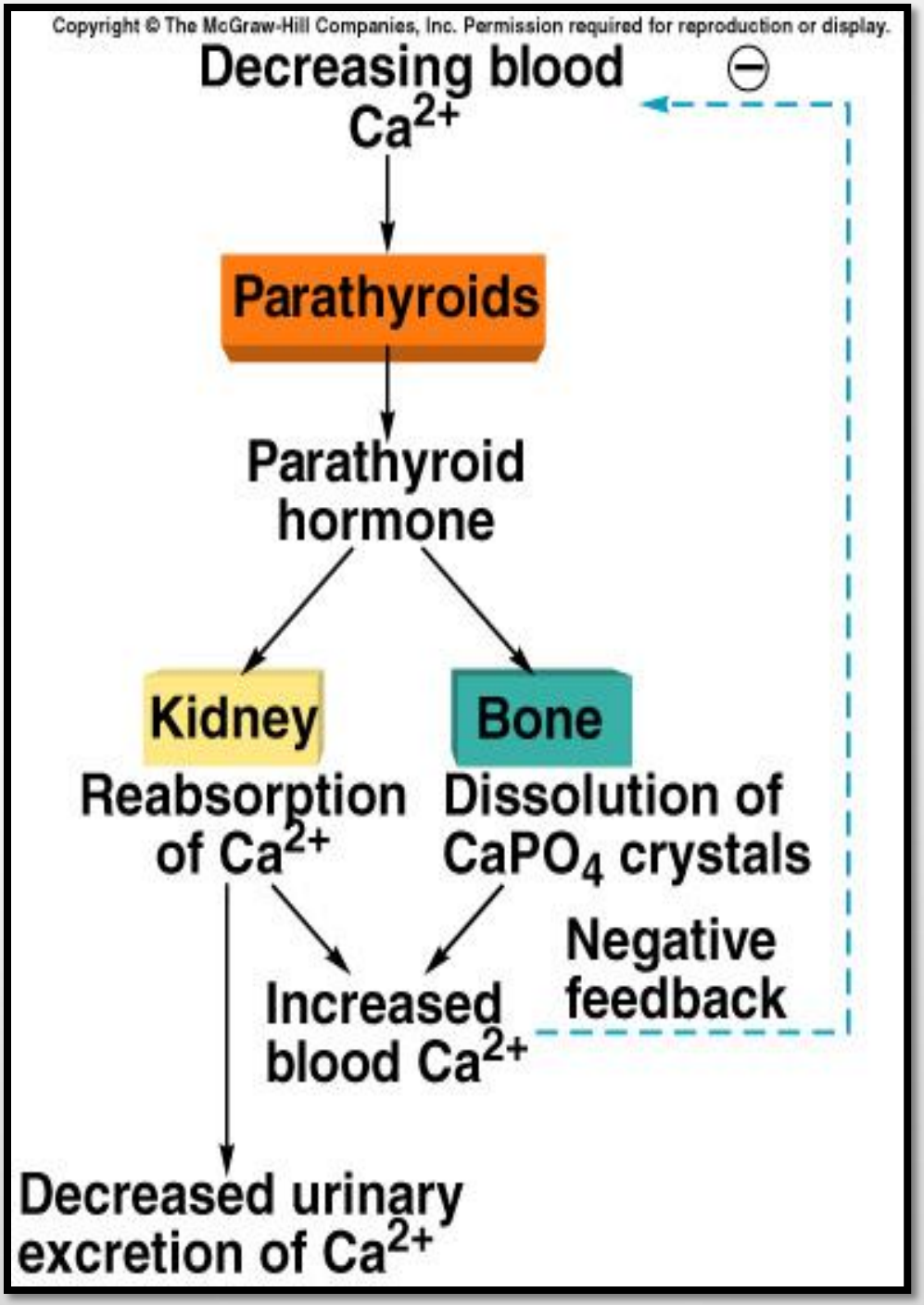
- **Autoimmune disorder:**
  - **Exerts TSH-like effects on thyroid.**
    - **Not affected by negative feedback.**

3 - Cretinism:

- **Hypothyroid from end of 1st trimester to 6 months postnatally.**
  - **Severe mental retardation.**

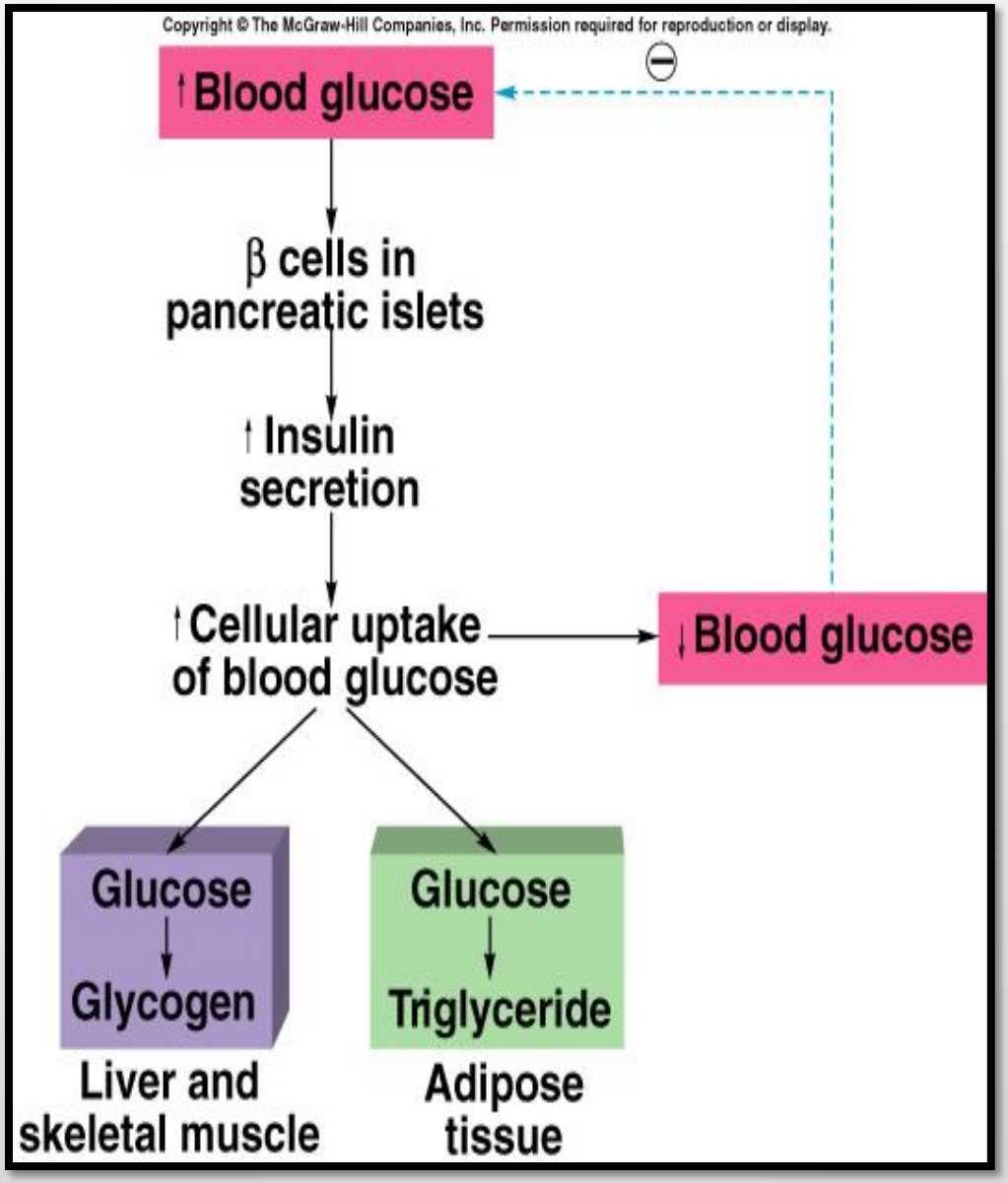
4 - Parathyroid Glands

- **Embedded in the lateral lobes of the thyroid gland.**
- **Parathyroid hormone (PTH):**
  - **Only hormone secreted by the parathyroid glands.**
- **Single most important hormone in the control of blood [Ca^{2+}].**
- **Stimulated by decreased blood [Ca^{2+}].**
- **Promotes rise in blood [Ca^{2+}] by acting on bones, kidney and intestines.**



5 - Pancreatic Islets (Islets of Langerhans)

- **Alpha cells secrete glucagon.**
  - **Stimulus is decrease in blood [glucose].**
  - **Stimulates glycogenolysis and lipolysis.**
  - **Stimulates conversion of fatty acids to ketones.**
- **Beta cells secrete insulin.**
  - **Stimulus is increase in blood [glucose].**
  - **Promotes entry of glucose into cells.**
  - **Converts glucose to glycogen and fat.**
  - **Aids entry of amino acids into cells.**

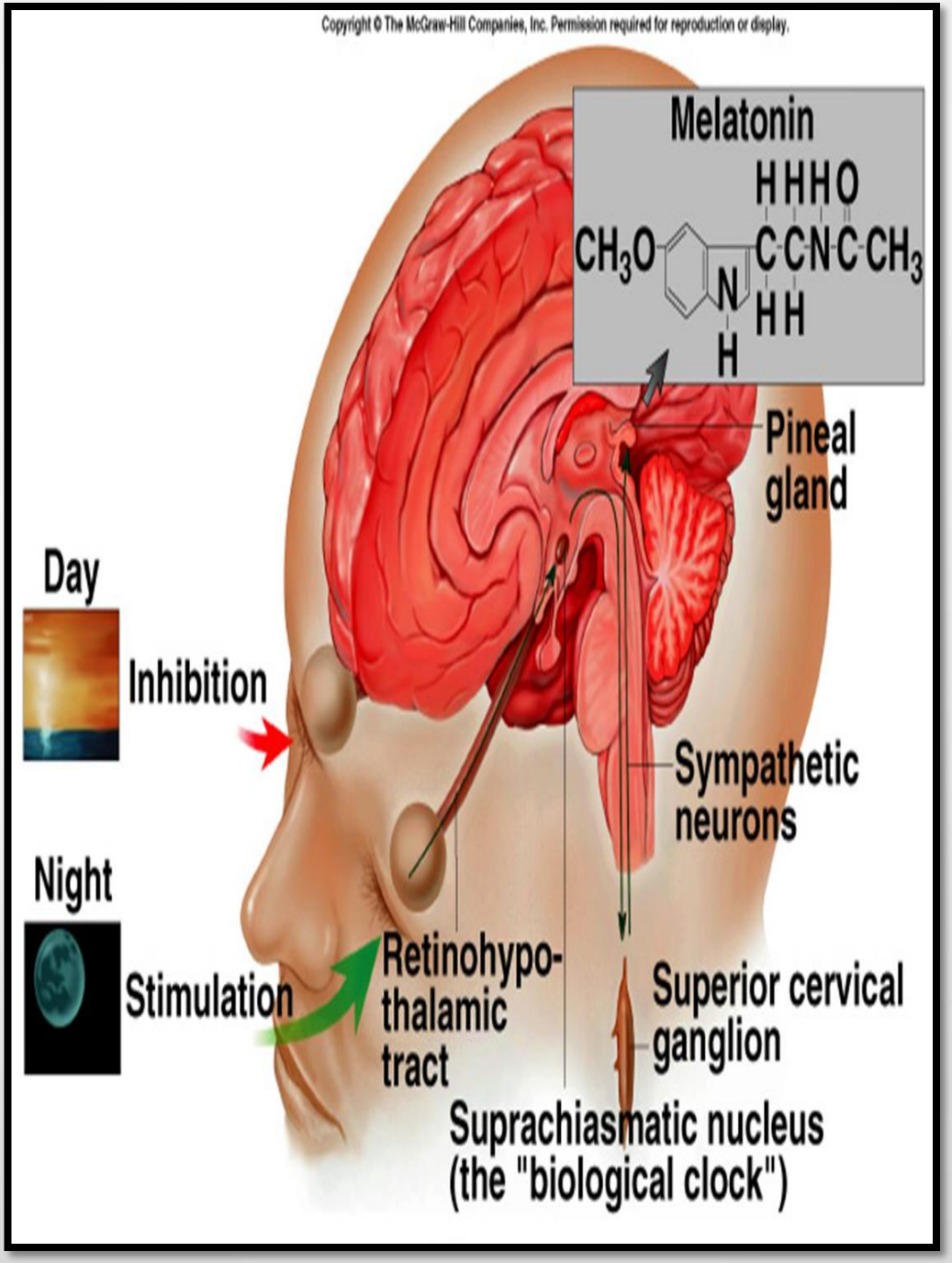


6 - Pineal Gland

Secretes melatonin:

- **Production stimulated by the suprachiasmatic nucleus (SCN) in hypothalamus.**
  - **SCN is primary center for circadian rhythms.**
  - **Light/dark changes required to synchronize.**
  - **Melatonin secretion increases with darkness and peaks in middle of night.**
- **May inhibit GnRH.**

May function in the onset of puberty (controversial).



Autocrine and Paracrine Regulation

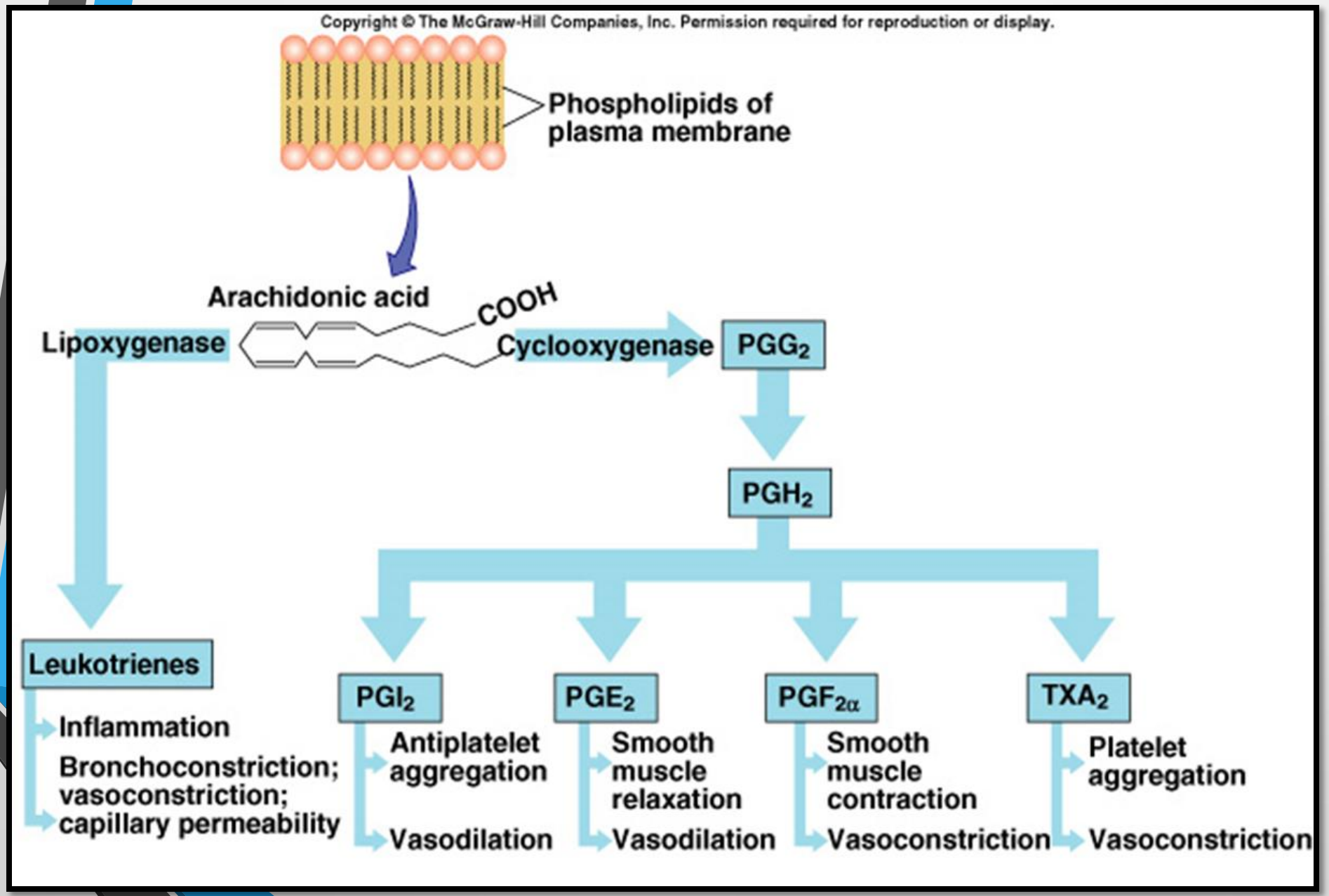
- **Autocrine:**
  - **Produced and act within the same tissue of an organ.**
    - **All autocrine regulators control gene expression in target cells.**
- **Paracrine:**
  - **Produced within one tissue and regulate a different tissue of the same organ.**
- **Cytokines (lymphokines):**
  - **Regulate different cells (interleukins) .**
- **Growth factors:**
  - **Promote growth and cell division in any organ.**
- **Neutrophins:**
  - **Guide regenerating peripheral neurons.**

Prostaglandins

- **Most diverse group of autocrine regulators.**
- **Produced in almost every organ.**
- **Wide variety of functions.**
- **Different prostaglandins may exert antagonistic effects in some tissues.**

- **Immune system: Promote inflammatory process.**
- **Reproductive system: Play role in ovulation.**
- **Digestive system: Inhibit gastric secretion.**
- **Respiratory system: May bronchoconstrict or bronchodilate.**
- **Circulatory system: Vasoconstrictors or vasodilators.**
- **Urinary system: Vasodilation.**

Prostaglandins



- **Inhibitors of prostaglandin synthesis**

- **Non-steroidal anti-inflammatory drugs (NSAIDS).**
  - **Aspirin, Indomethacin, Ibuprofen: inhibit COX1.**
- **Celecoxib and Rofecoxib: inhibit COX2.**