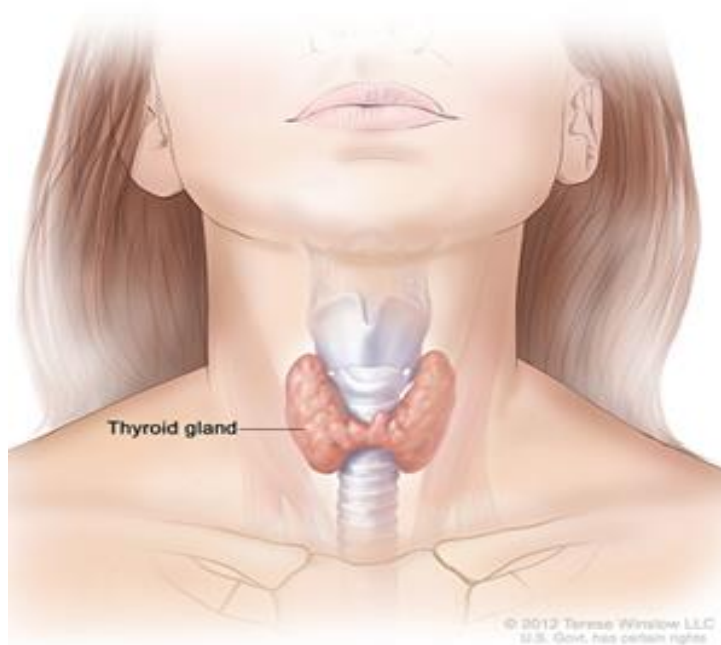


THYROID HORMONE



Dr.Yashoda Kattimani
Physiology
MGM MC NM



Competency PY. 8.2

Synthesis, secretion, transport, physiological actions, regulation and effects of altered secretion of thyroid gland

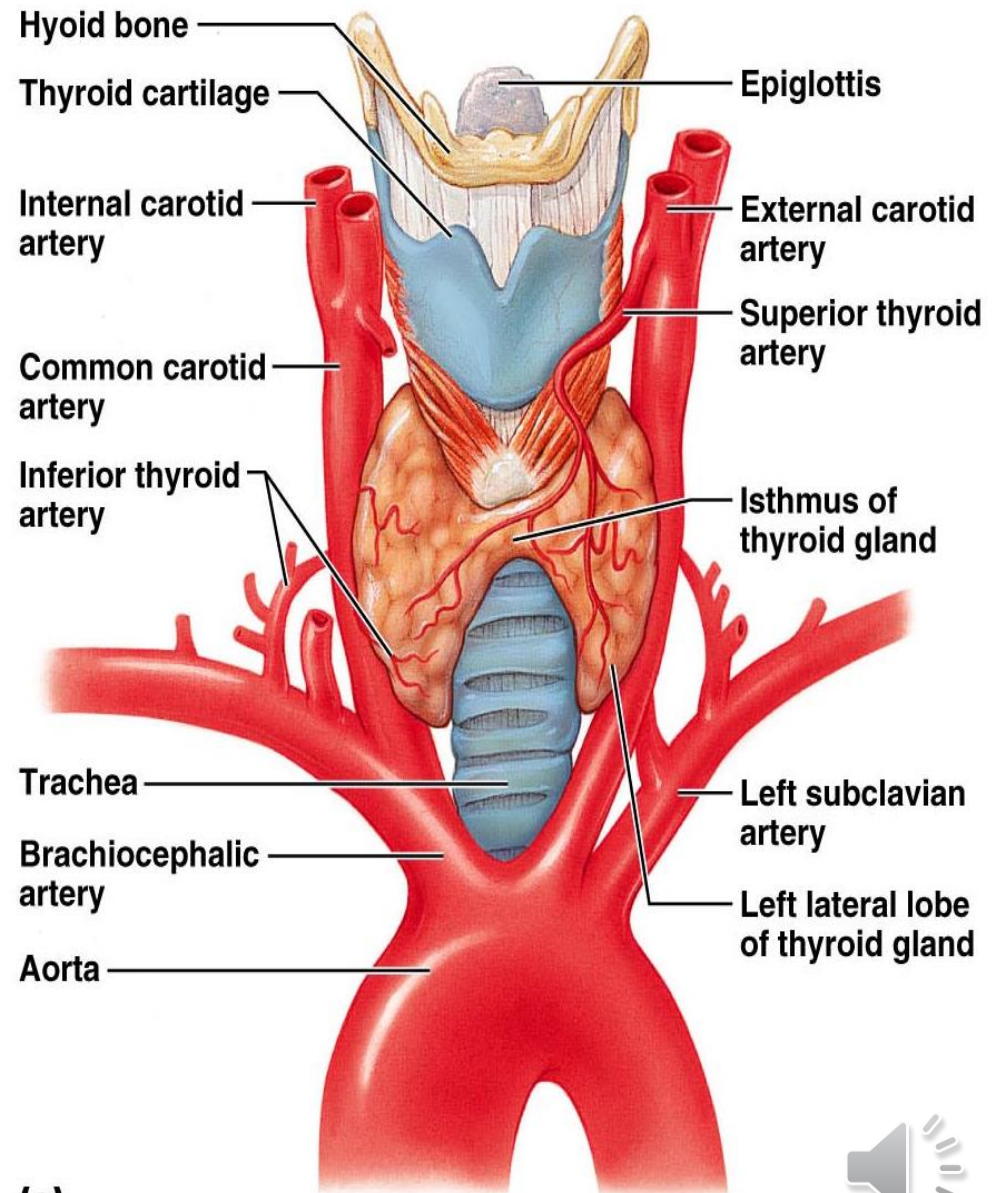
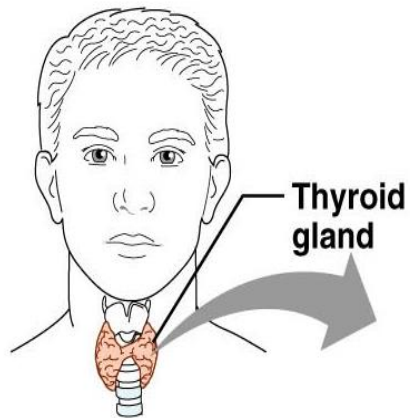
Specific Learning Objectives:

- **Physiological anatomy of Thyroid gland**
- **Synthesis and secretion of thyroid hormones**
- **Actions of thyroid hormones**
- **Regulation of secretion**

Introduction:

- Thyroid is the largest of the pure endocrine glands.
- Thyroid gland is located just below the larynx.
- It is made up of follicles.
- Follicular cells secrete T3 and T4 (thyroxine).
- Parafollicular cells secrete calcitonin

Physiological Anatomy

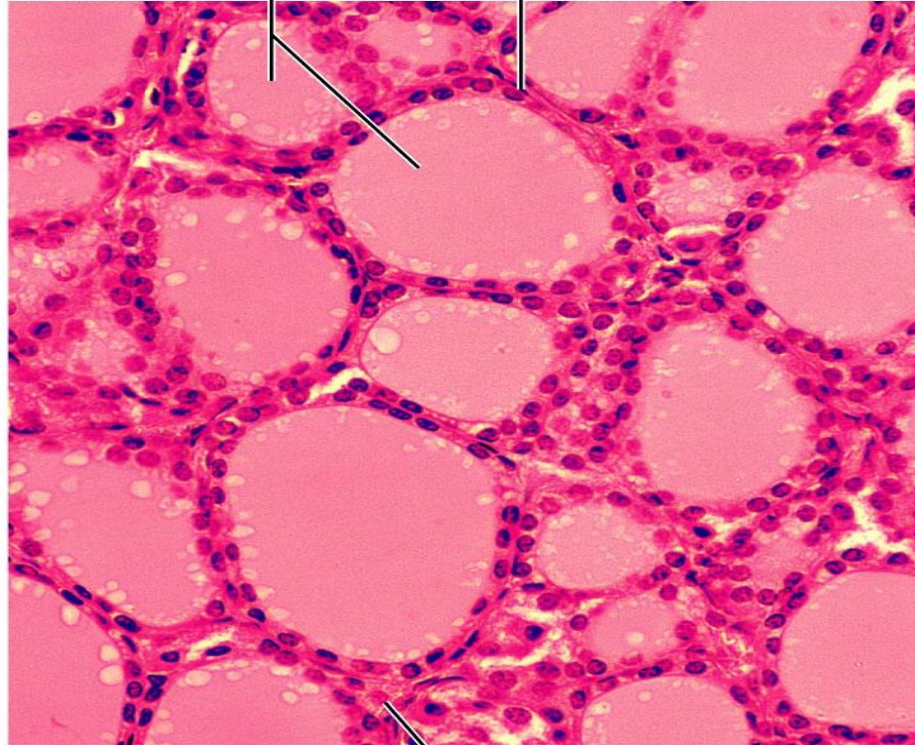


(a)



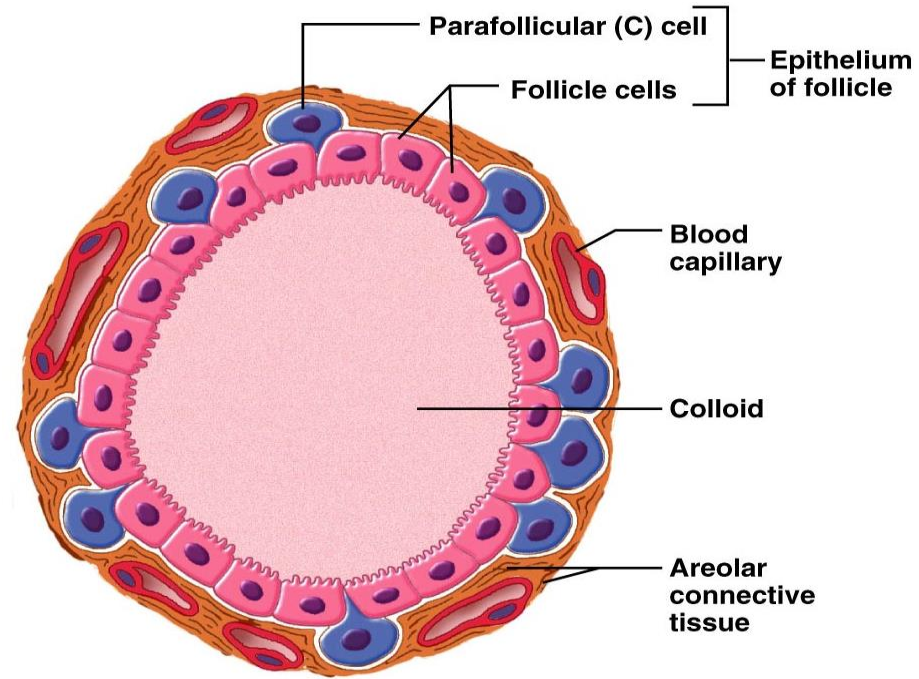
Histology

Colloid-filled follicles Follicle cell (secretes thyroid hormone)



Parafollicular cell (secretes calcitonin)

(b)



(c)





Thyroid Hormone Synthesis & Secretion

Steps in thyroid hormone synthesis

- Iodide trapping
- Formation & Secretion of TG
- Oxidation of Iodide ion
- Iodination of Tyrosine
- Coupling
- Organification
- Storage
- Secretion

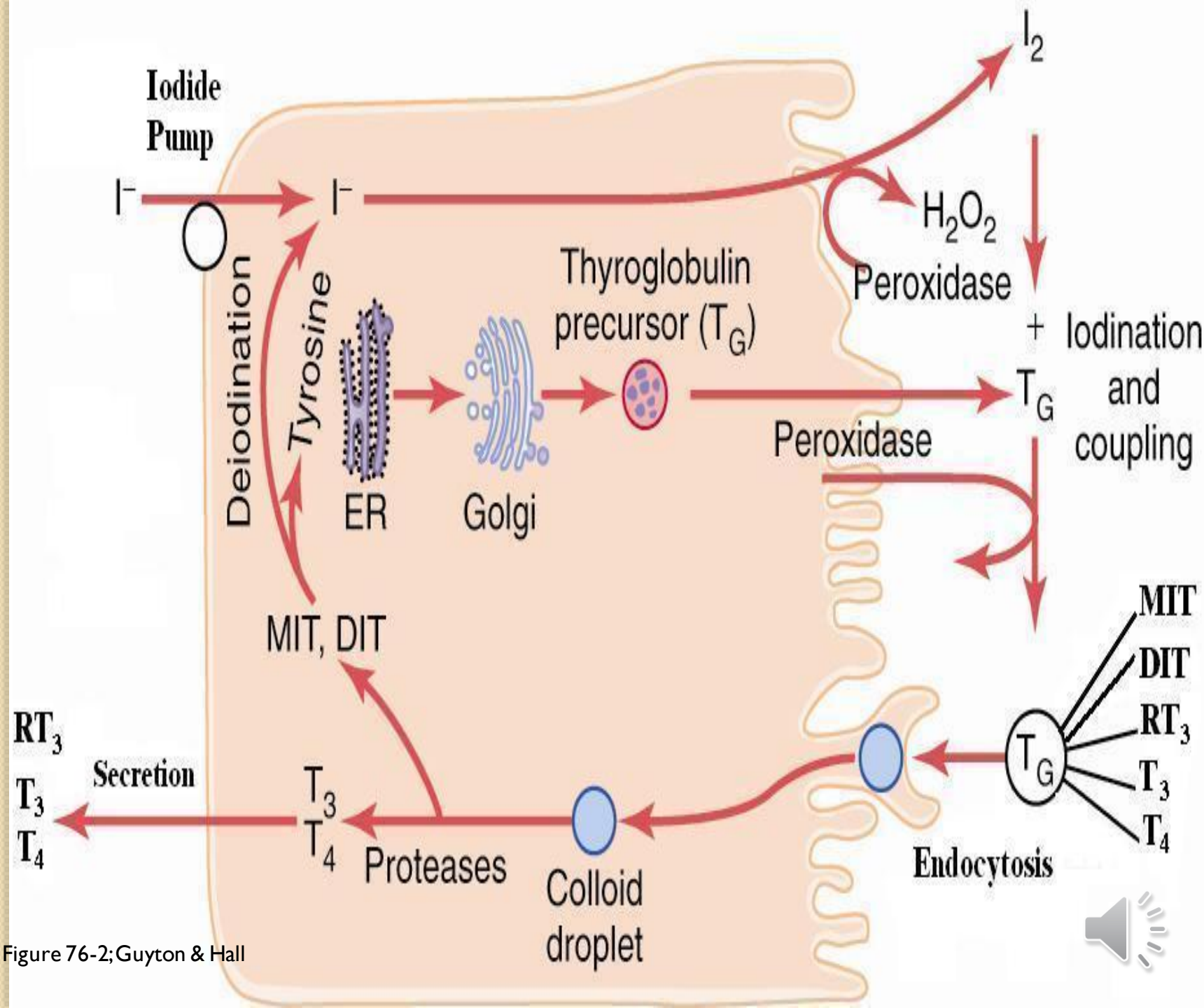


Figure 76-2; Guyton & Hall

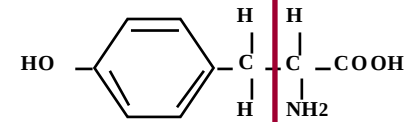


Iodination of Tyrosine and Organification of Thyroglobulin during Hormone Synthesis

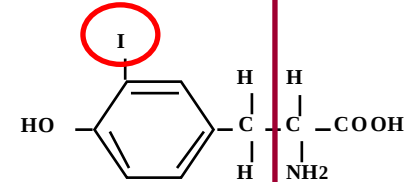
Iodinase



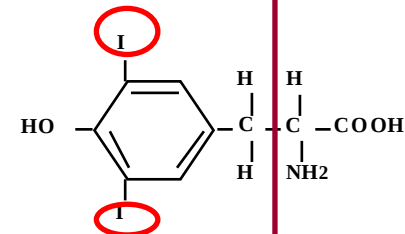
Tyrosine



3-Monoiodotyrosine (MIT)

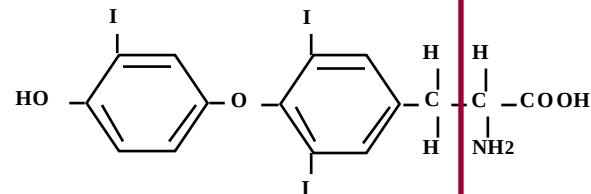


3,5-Diiodotyrosine (DIT)



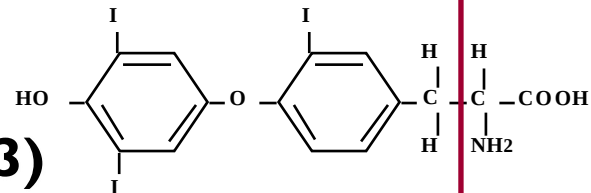
MIT+DIT

3,5,3'-Triiodothyronine (T3)



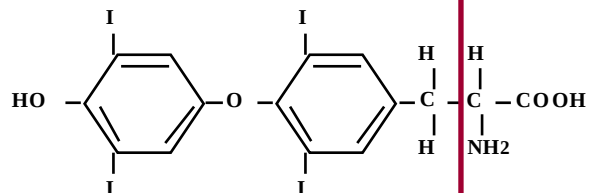
DIT+MIT

3,3',5'-Triiodothyronine (RT3)



DIT+DIT

Thyroxine (T₄)



Thyroglobulin Molecule



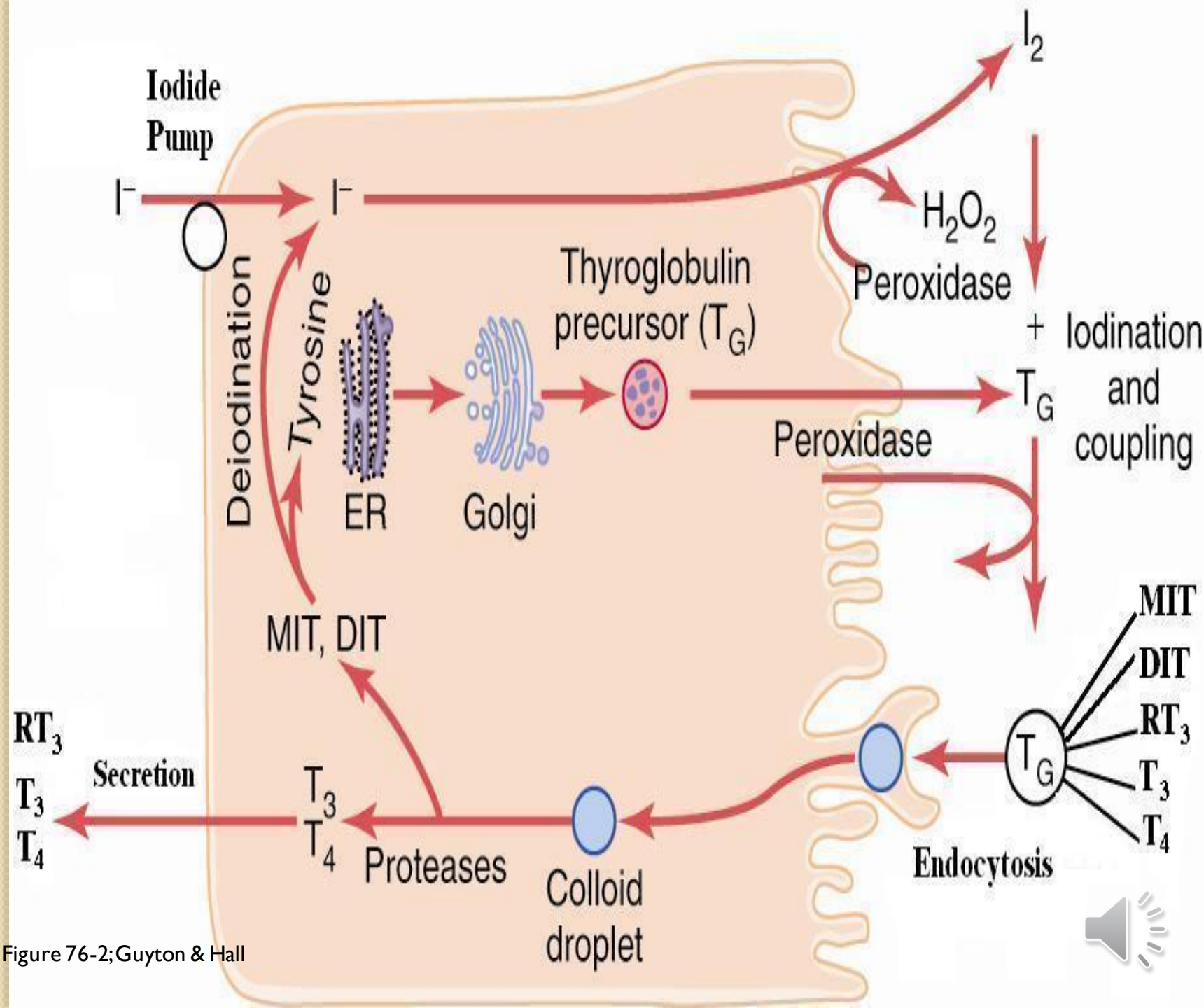


Figure 76-2; Guyton & Hall

Transport of hormones

Thyroxine -binding globulin

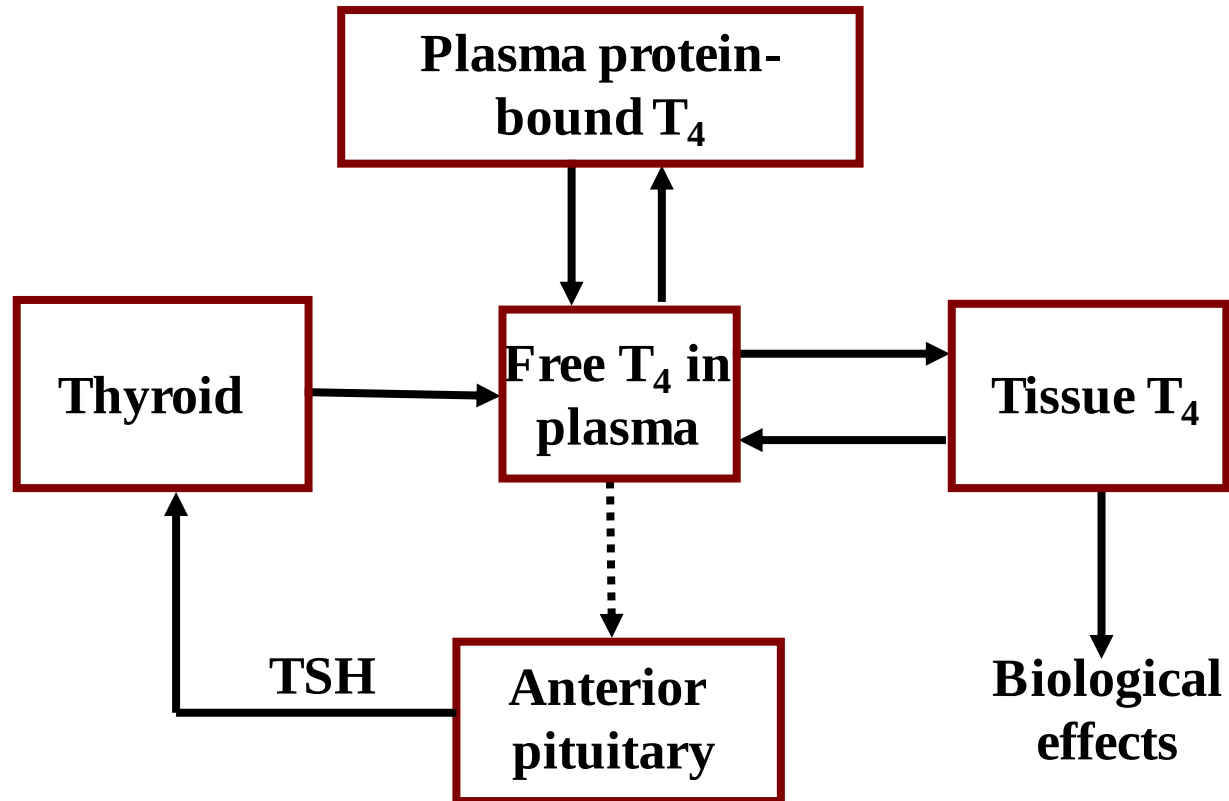
Thyroxine –binding prealbumin
(transthyrein) & albumin

99% -T4

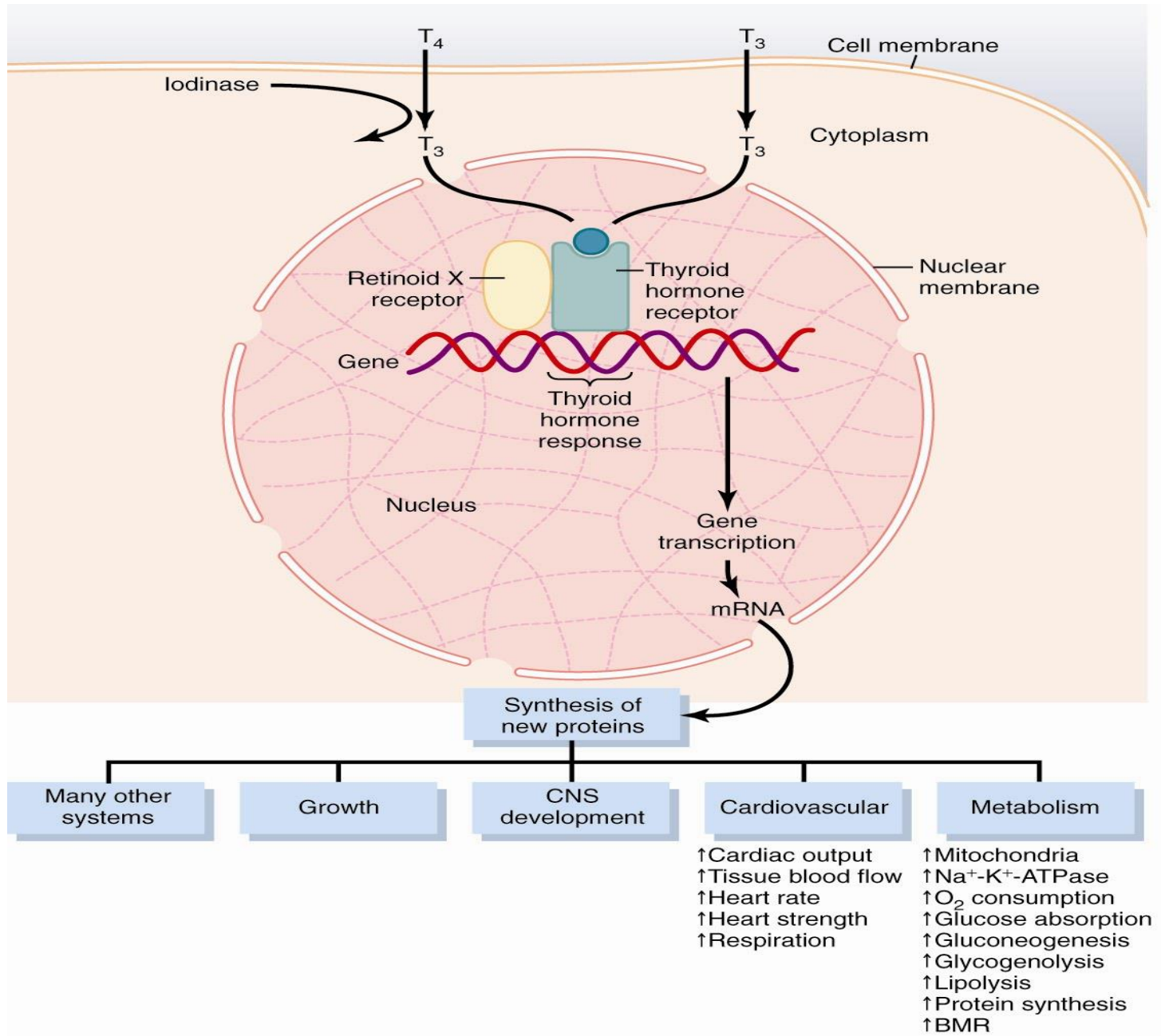
T3-1/2L-1 day, LP-6-12hrs, max acty-2-3days

T4-1/2L-6days, LP-2-3days, max-15days

Interrelationships Between Free & Bound T_4



Mechanism of action





ACTIONS OF THYROID HORMONE

Effects on Maturation and Differentiation

❖ Amphibian Metamorphosis

- Tadpole to Adult frog

❖ Human

- Bone maturation
- Perinatal lung maturation
- Puberty

Effects on Neurological tissue/ CNS

- ❖ Fetal and Neonatal brain development
- ❖ Neuronal proliferation and differentiation
- ❖ Myelinogenesis
- ❖ Neuronal out growth
- ❖ Synaptic formation

Brain development –critical period- in utero to 2 yr post natal

Thyroid deficiency –
structural and
physiological impairment
of function

Replacement therapy
cannot reverse the
damage

Mental Retardation

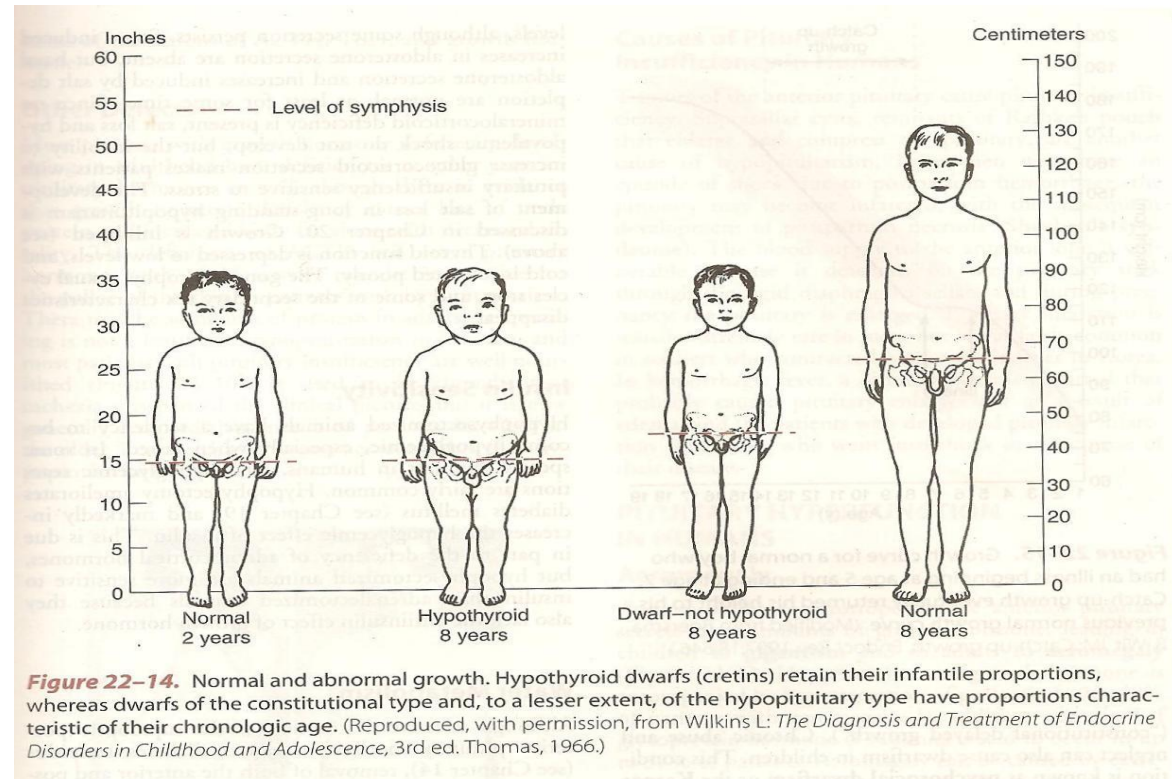
Adult

Hypo – dull, lethargic, prolonged
reaction time, excess sleepiness

Hyper- extreme nervousness,
excitable, lack of sleep, restless,
psychological disturbances

Effect on general growth

- ❑ Thyroid hormone is essential for normal physical growth
- ❑ Decrease in thyroid hormone leads to decrease in GH and IGF



Effects on Metabolism

Cellar metabolism

- Increase in metabolic activity of all cells in the body
- Increase in BMR 60-100 times
- Increase Caloric action
- Increase Heat production
- Increase Rate of utilization of food for energy
- Increase Growth
- Increase Mental activity
- Increase In size and activity of mitochondria
- Increase Activity of Na-K pump
- Increase in all cell all metabolic pathways.

Protein metabolism

Moderate dose – protein anabolism

High dose – Protein catabolism

Increase uptake of AA

Fat metabolism

Stimulates lipogenesis & lipolysis

More degradation than synthesis

Hypo- Increase in body fat

Hyper – Decrease in total body fats

Carbohydrate metabolism

Stimulates all aspect

Increase rate of GI absorption of glucose

Uptake of glucose glycolysis, gluconeogenesis

Increase Insulin secretion

Effects on CVS

- ❖ Increase in HR, CO, SBP

- ❖ Heart-

- ☐ Increase concentration of myosin & actins

- ☐ Increase Na-K pump activity

- ☐ Increase Myosin ATPase activity

- ☐ Myocardial contractility

- ☐ Increase Myocardial hypertrophy

- ❖ Decrease Peripheral resistance

- ❖ Thus Increase SBP & Decrease DBP

- ❖ Hence Increase Pulse pressure

Effect on skeletal muscles

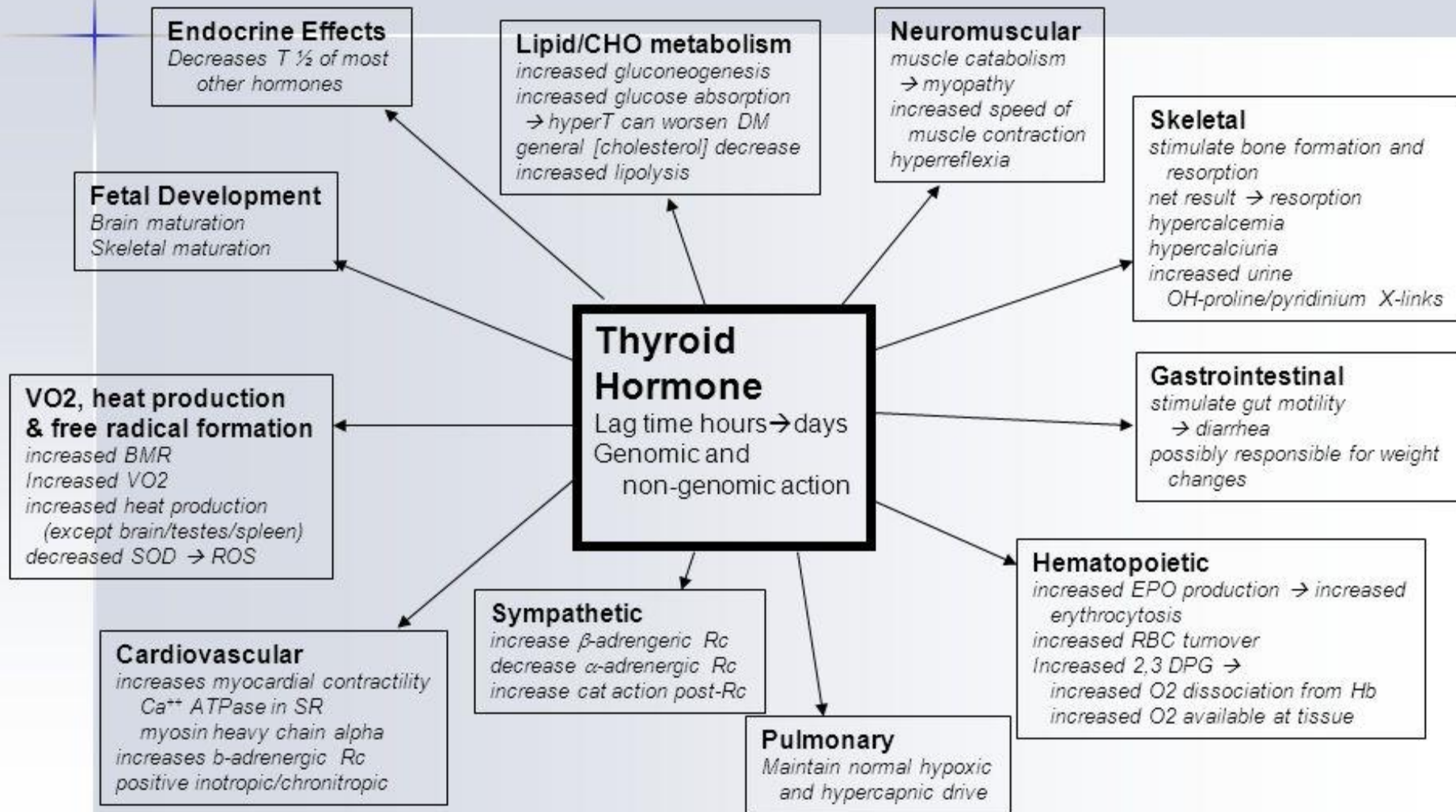
- ❖ Increase Na-K pump No. & RMP
- ❖ Increase Na-K pump activity
- ❖ Increase Ca pump activity & uptake of Ca in SR
- ❖ Increase Myosin ATPase activity
- ❖ Increase Max shorting velocity

Hypo- muscle stiffness, delayed relaxation, slow movements, impaired muscle glycogen

Hyper- muscle weakness, wasting , fatigue.

Thyroid Hormones

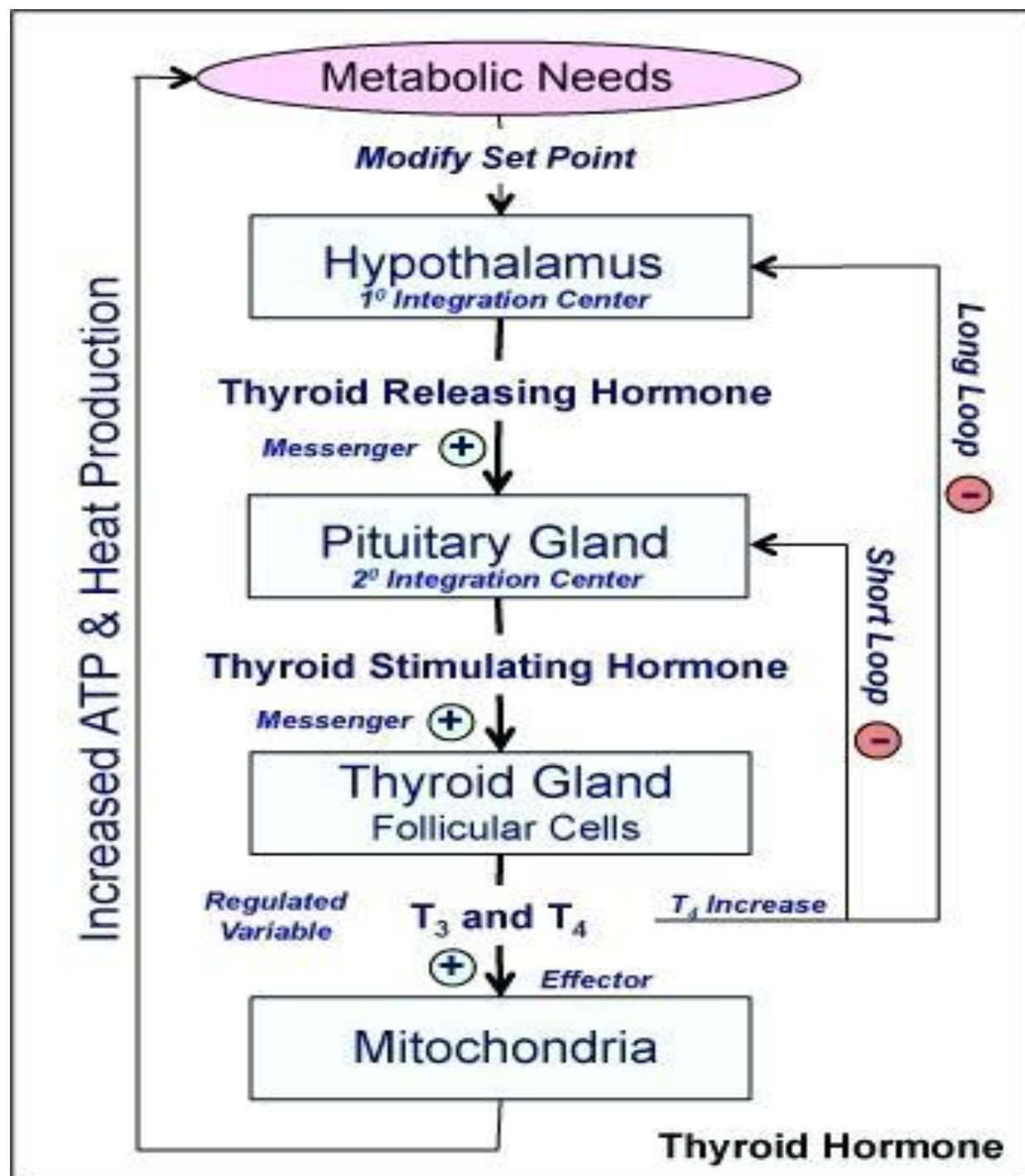
Action of Thyroid Hormones - Physiologic effects





Regulation of Hormone Secretion

HYPOTHALAMIC- PITUITARY- THYROID AXIS



Effects of TSH on Thyroid gland

- TSH (from the Anterior Pituitary Gland) Increases Thyroid Secretion by
 1. *Increased proteolysis of the thyroglobulin*
 2. *Increased activity of the iodide pump,*
 3. *Increased iodination of tyrosine*
 4. *Increased size and increased secretory activity of thyroid cells*
 5. *Increased number of thyroid cells- change from cuboidal to columnar*

Assignment :

LAQ :

Describe actions and regulation of thyroid hormones in the body. (7+3marks)

SAQ :

Synthesis of Thyroid hormone (5 marks)

Note : disorders of thyroid hormone will be covered in practical demo class along with endocrine photos graphs