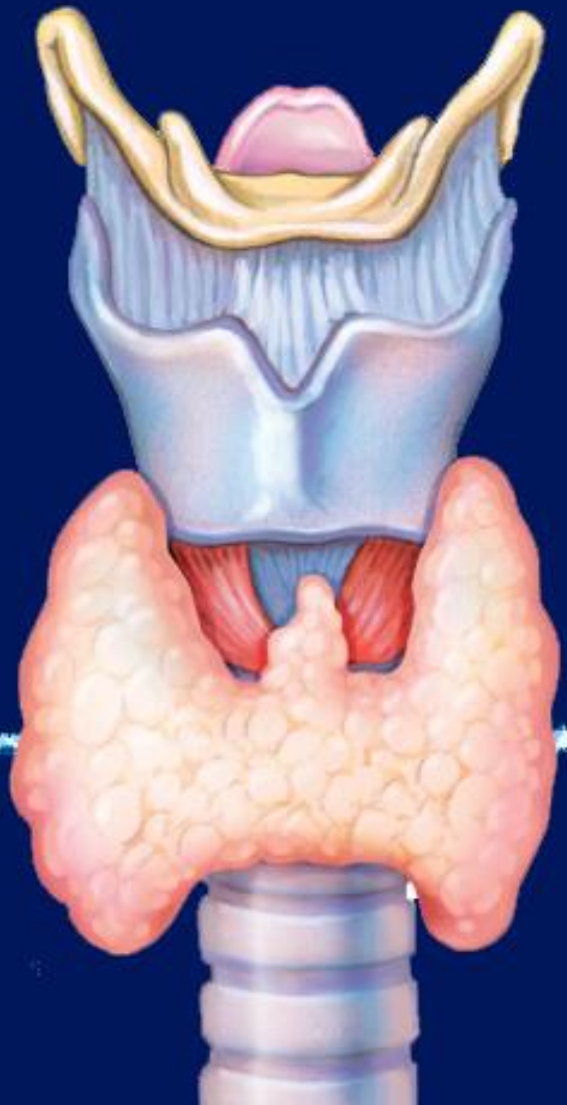
Thyroid gland

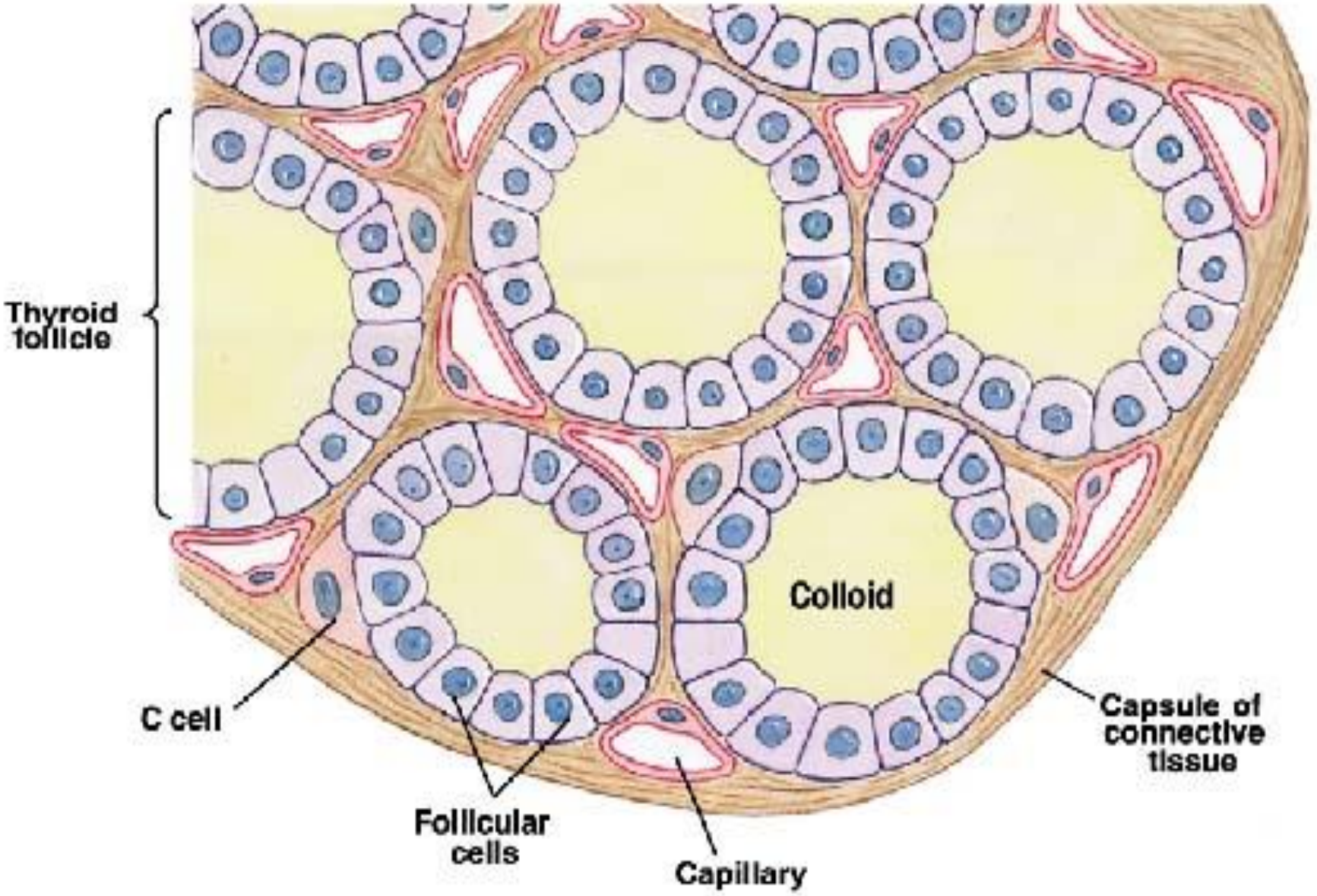
Dr. Nour A. Mohammed
MUTAH SCHOOL OF MEDICINE



Structure

- It is formed of two lobes connected by a narrow isthmus .
- The gland is formed of thyroid follicles , each follicle is surrounded by a single layer of epithelial cells and its lumen is filled with a protein material called colloid (which is formed and secreted by follicular cells).
- In between the follicles there are other cells called parafollicular cells .
- The gland is richly supplied with blood vessels .

Section of thyroid gland



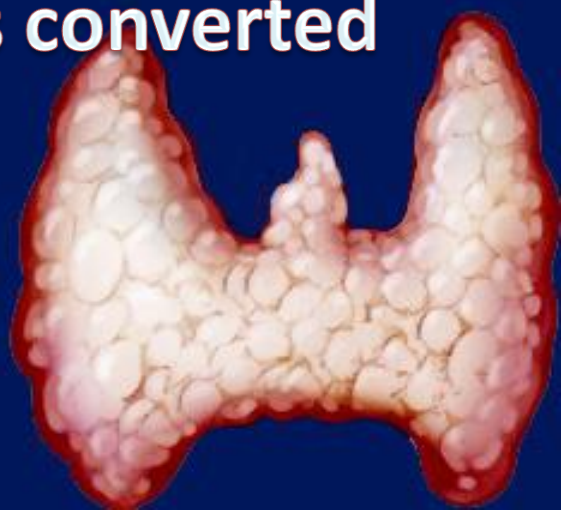
Thyroid hormones :

1. Thyroxine (T_4) : tetraiodothyronine
2. Triiodothyronine (T_3)

   both T_3 & T_4 are formed by thyroid follicles
3. Calcitonin : secreted by parafollicular cells (C cells) it causes lowering of blood Ca^{++} level .

Transport of thyroid hormone

- Once T_3 and T_4 enter the circulation , they bound to plasma proteins and only less than 1% of the hormones are free .
- This free form of the hormone is the active form that can perform its actions .
- T_3 is more active than T_4 and T_4 is converted to T_3 inside target cells .



Mechanism of action :

- Thyroid hormone enter the cells , bind to the receptor in the nucleus → increase transcription of mRNA that stimulate the production of various enzymes in the ribosomes .

Types of thyroid receptors:

a) hTRα	b) hTRβ
Present All over the body For general metabolic function	1) In Brain (for development & maturation of CNS). 2) In Pituitary (for control of TSH secretion -ve FB).

Actions of T_3 and T_4

1. Metabolic function :

a. Calorigenic action :

Thyroid hormones increase O_2 consumption, heat production and basal metabolic rate (BMR).

b. On protein metabolism :

Normal level of thyroid hormones increase protein synthesis (anabolic effect) .

High level of thyroid hormones increase protein breakdown (catabolic effect) .

c. On carbohydrate metabolism :

Thyroid hormone increase glucose absorption from GIT so blood glucose increase after meal , but rapidly fall to normal level again due to increased uptake of glucose by the tissues to be used for energy production .

d. On lipid and cholesterol metabolism :

They lower blood lipid and cholesterol by increasing its removal from circulation by the liver.

e. Stimulate conversion of carotenes to vitamin A in the liver .

2. Effect on growth and development :

Thyroid hormones are necessary for growth and maturation of most tissues.

3. On CNS :

- **Thyroid hormones are essential for normal brain development during fetal life and in children .**
- **In adult , they increase response of brain to catecholamines and increase activity of reticular activating system (RAS) .**

4. On CVS :

a. They increase all cardiac properties by increasing number and affinity of B adrenergic receptors (to catecholamines) and by direct effect which lead to :

- Increase heart rate (H.R.)
- Increase stroke volume (S.V.)
- Increase cardiac out put (COP)
- Increase systolic blood pressure .

b. Cutaneous V.D occurs by the produced heat .

↓ peripheral resistance causes decreased diastolic blood .

c. Increased pulse pressure.

5. On respiration :

- shift of O_2 curve to Rt by increasing 2,3 DPG in RBCs
- Increase pulmonary ventilation due to increased metabolic rate with more O_2 utilization and more CO_2 formation (through activation of chemoreceptors) .

6. On GIT :

- Increase appetite and food intake .
- Increase GIT motility .

7. On sex functions :

- Thyroid hormone are essential for normal menstrual cycle and fertility

Regulation of thyroid hormone

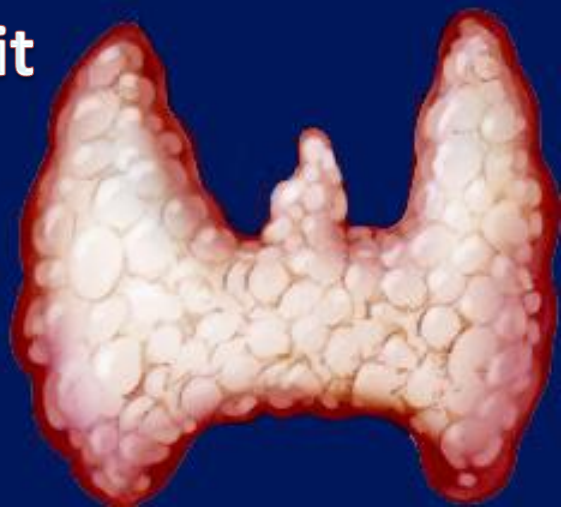
1. Hypothalamic regulation :

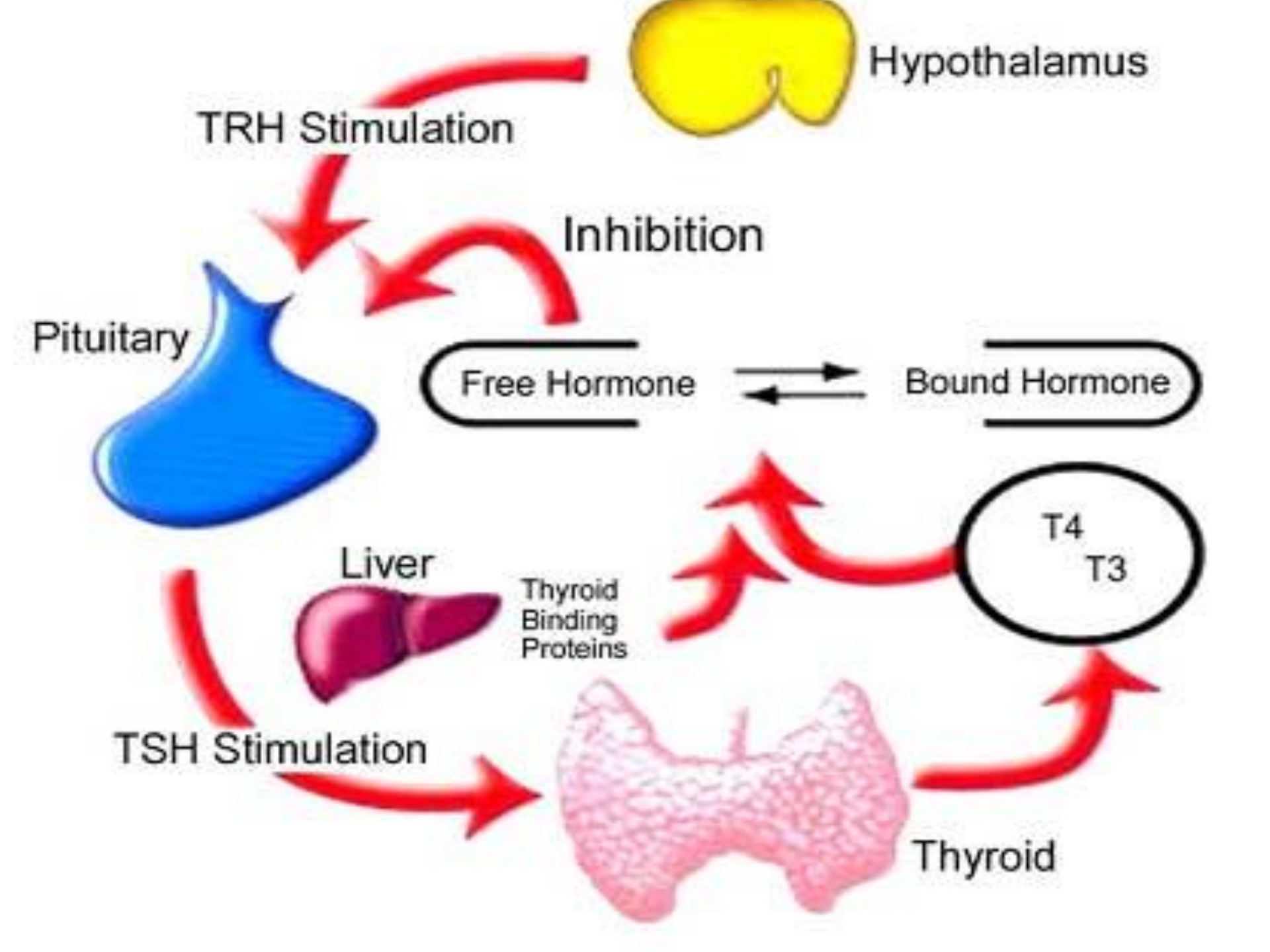
1. TRH (thyrotropin releasing hormone)

- **Exposure to cold increase TRH release .**
- **Stress , emotions and warmth decrease TRH**

2. Somatostatin :

- **It inhibit TSH secretion thus it inhibit thyroid hormone secretion .**



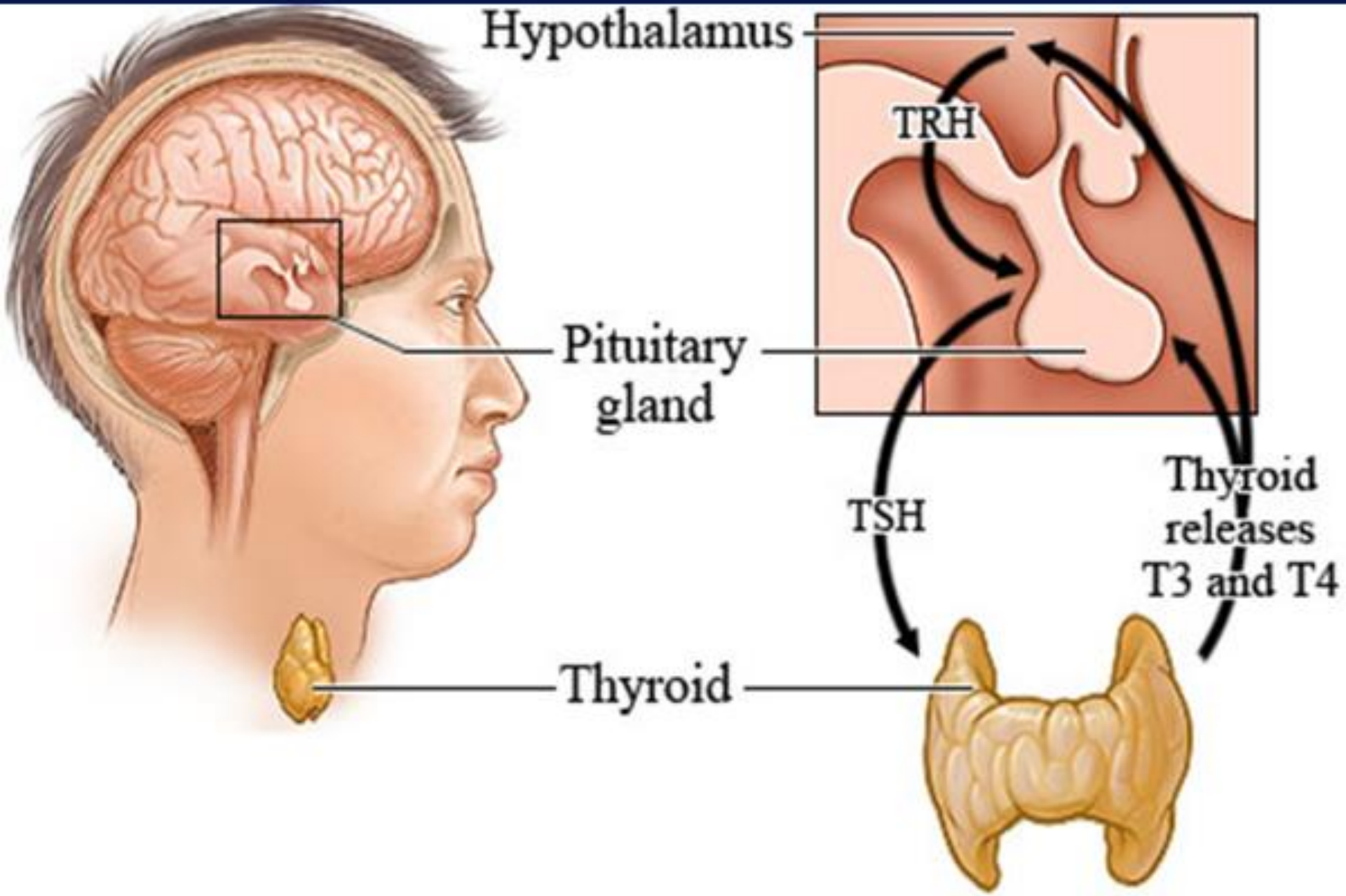

Hypothalamus
TRH Stimulation
Inhibition
Pituitary
Free Hormone
Bound Hormone
T4
T3
Liver
Thyroid
Binding
Proteins
TSH Stimulation
Thyroid

2. Pituitary regulation (TSH)

3. Feedback regulation :

- ↑ free T_3 and T_4 in blood inhibit TSH secretion by negative feedback on anterior pituitary and hypothalamus .

- Thus , when free T_3 and T_4 decreased in blood TSH secretion will be increased .


Hypothalamus
TRH
Pituitary gland
TSH
Thyroid releases T3 and T4
Thyroid
© Healthwise, Incorporate

4. Blood iodide level :

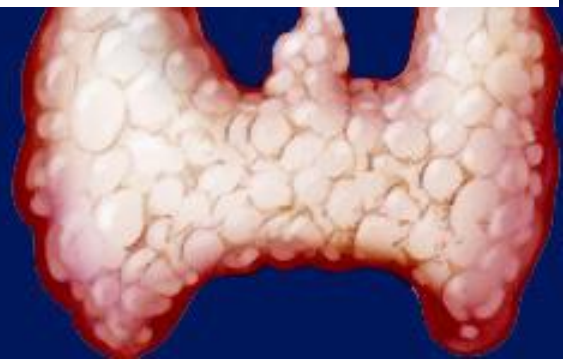
- Adequate dietary iodine intake is essential for normal thyroid function .

- Decreased iodine intake → ↓ T3 and T4 synthesis and release → ↑ TSH → ↑ size of the gland = thyroid enlargement (goiter)

B. Excess iodine administration:

- Depends on the state of the person:

Normal person	Hypothyroidism	Hyperthyroidism
- Iodine is stored in the gland without any increase in thyroxin level.	- ⇩ Iodine ⇨ ⇩ thyroxin ⇨ compensatory hyperplasia & enlargement of the gland due to increased TSH as a -ve feed back - Excess iodine ⇨ the gland returns to normal condition & decreases the hyperplasia. - Because iodine inactivates TSH	- Excess iodine ⇨ ⇩ thyroxin formation due to inactivation of TSH and inhibition of thyroxin biosynthesis. - This is called: **Wolff-Chaikoff effect** Administration of excess iodine ⇨ inhibition of organification of trapped iodide & inhibition of all steps of thyroxin formation.



Goiter

Definition : goiter is non-inflammatory and non-malignant thyroid enlargement .

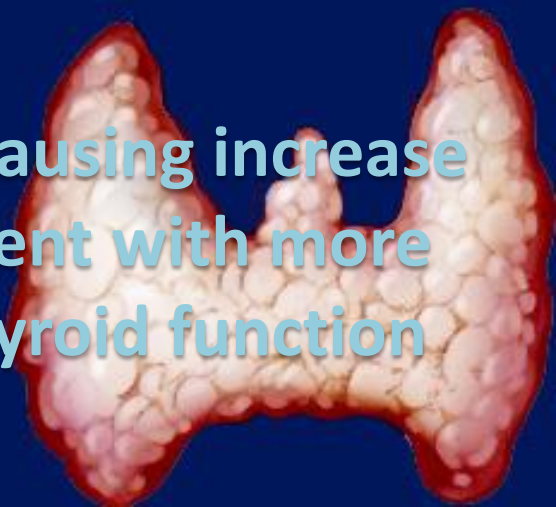
- **Types :**

1. Simple goiter :

It is associated with **normal thyroid function**

It is due to :

- **Mild iodine deficiency**
- During puberty and pregnancy , **due to increase need for iodine .**
- Thyroid hormone decreased at first causing increase in **TSH** which causes thyroid enlargement with more formation of thyroid hormone thus thyroid function remains normal .



2. Colloid Goiter :

Cause : severe iodine deficiency

Here , the enlarged thyroid gland can't synthesize excess thyroid hormone due to sever iodine deficiency .

It is associated with hypothyroidism .

3. Toxic Goiter : This thyroid enlargement is associated with **thyroid hyper function .**

it is called **Graves' disease .**

it is an **auto immune disease** in which the immune system secretes auto antibodies called long- acting thyroid stimulators **(LATS) .**

These antibodies activate TSH receptors producing hyperthyroidism due to increased formation of thyroid hormone .

- **LATS** have long duration of action .


THank you