Endocrine Disorders

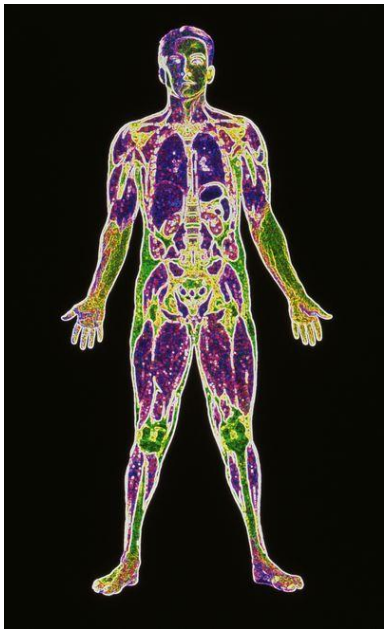
CHAPTER 24

1

Have you ever thought about the way the different parts of our body communicate?

- our body is composed of lots of parts.
  - systems.
    - organs.
      - tissues.
        - cells.

- there are at least, roughly, 100 trillion cells in our body.



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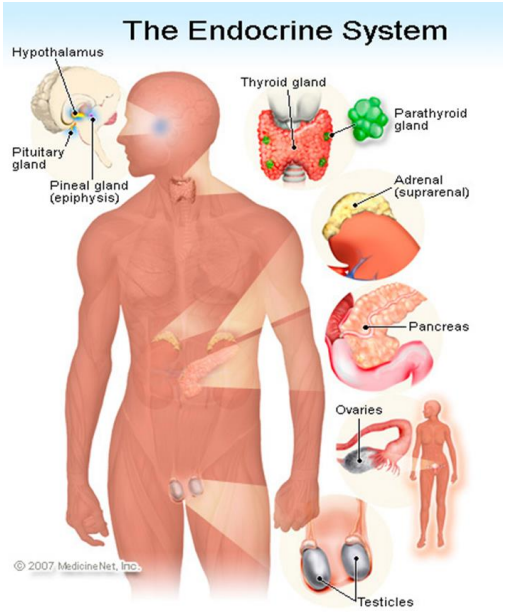
how do those 100 trillion different parts communicate?

- one way is **through the nervous system** and through the pre-laid tracks of nerves.
- But not every part of the body is connected by nerves.
  - *Ex:* how a part of the brain communicate with part of the kidney?
    - We need the endocrine system.
- And the **endocrine system** is a system of organs that are called **glands**.



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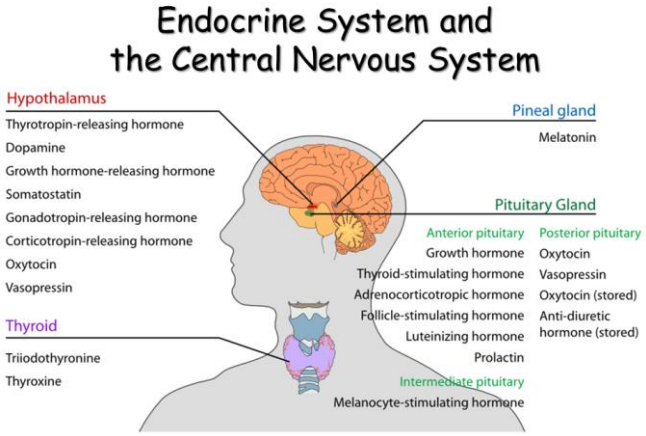
- The endocrine system has a unique relationship with:
  - the immune system
  - the nervous system.
- Chemicals released by the nervous system (neurotransmitters – epinephrine, etc.) can also function as hormones when needed



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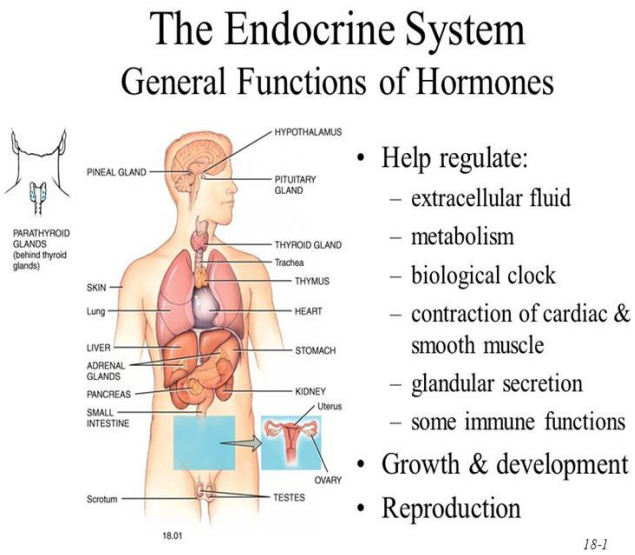
Endocrine system

Plays vital role in orchestrating:

- cellular interactions,
- metabolism,
- growth,
- reproduction,
- aging,
- and response to adverse conditions



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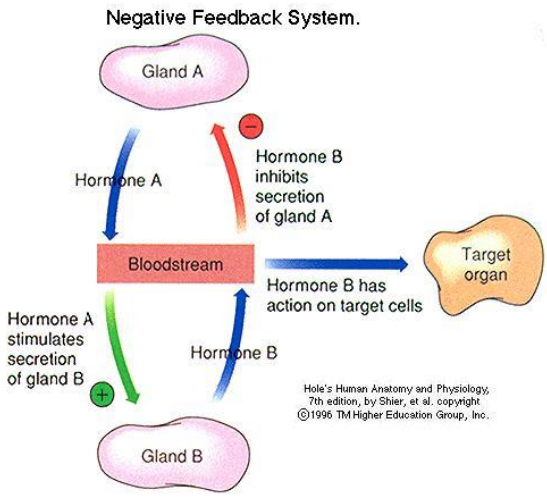
- Hormones are the body's chemical messengers.
- To prevent accumulation:
  - hormones must be inactivated continuously by a negative feedback system:
    - when the hormone concentration increases, further production of that hormone is inhibited.
    - when the hormone concentration decreases, the rate of production of that hormone increases.



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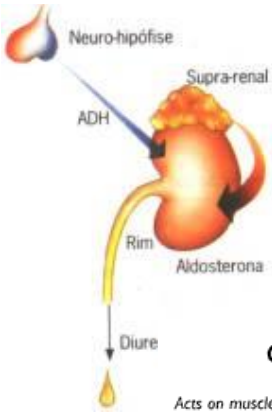
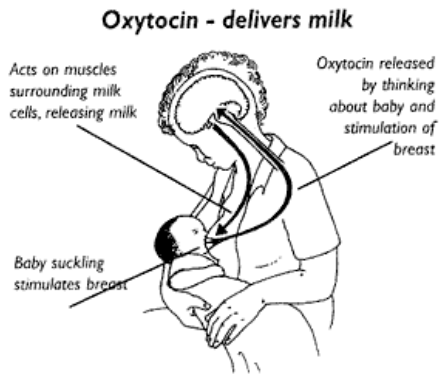
hypothalamus

- **stimulates the pituitary gland**
- **make some hormones itself: ADH and oxytocin.**

➢antidiuretic hormone (ADH)
- ➢a main regulator of our fluid volume in our body.
- ➢also called arginine vasopressin (AVP)
- ➢stored and released by the posterior pituitary

➢oxytocin (OXT)
- ➢stimulates the uterus to contract
- ➢during pregnancy.





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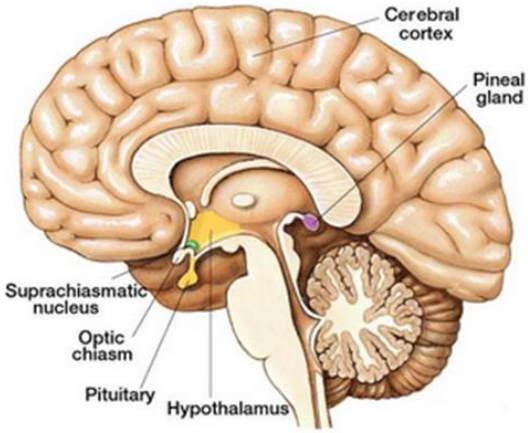
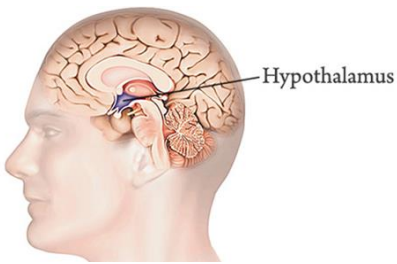
HYPOTHALAMIC-PITUITARY-HORMONE AXIS

The hypothalamus and pituitary gland are in communication with each other via specialized neurovascular tissue called the hypothalamus–hypophyseal portal system.

There is a unique relationship between the hypothalamus, pituitary, and endocrine glands.
- Hypothalamus: the coordinating center of the endocrine system
  - delivers precise signals to the pituitary gland.
- Pituitary gland (hypophysis):
  - releases a specific tropic hormone that stimulates a specific endocrine target organ.





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Hypothalamus

- hypothalamus = about the size of a grape.

- pituitary = about the size of a green pea.
  - But this little green pea is so important that it's called the **master gland**.

  - the pituitary gland **takes the stimulation from the hypothalamus**
    - and it **directs it to all of the other endocrine glands,** or at least almost all of the other endocrine glands, so that their function is ultimately dependent on the pituitary gland to work well.

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Basic Pathophysiological Concepts of Endocrine Dysfunction

Endocrine dysfunction occurs when the hypothalamus–pituitary–hormone axis is disrupted.

three major types of conditions:

1. Hormone deficiency

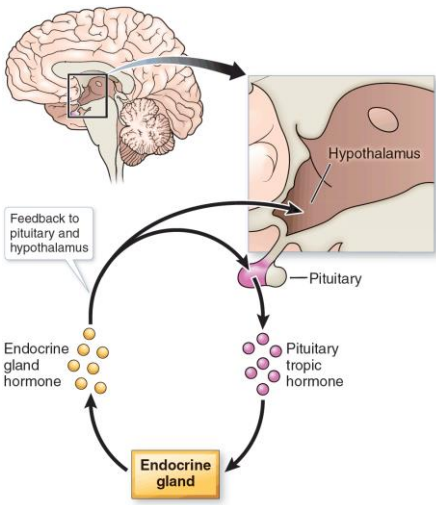
autoimmunity, infection, inflammation, infarction, tumor

2. Hormone excess

tumor, autoimmune disorders, or genetic mutations

3. Hormone resistance

defective hormone action at the receptor



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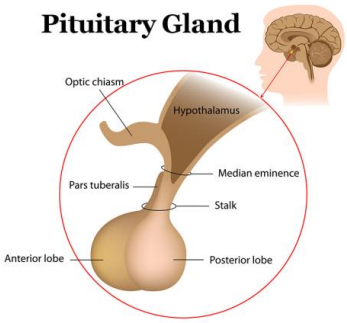
Pituitary Gland: Hypophysis

- **ANTERIOR**
  - FSH, LH, prolactin, ACTH, TSH, GH
- **Hyper:**
  - Cushing syndrome
  - Gigantism
  - acromegaly
- **Hypo:**
- Dwarfism
- panhypopituitarism



- **POSTERIOR**
  - ADH, vasopressin, oxytocin
- **Hyper:** SIADH (syndrome of inappropriate antidiuretic hormone secretion)
- **Hypo:** DI (Diabetes insipidus)
  - Tumors: 95% benign
  - Surgery: hypophysectomy

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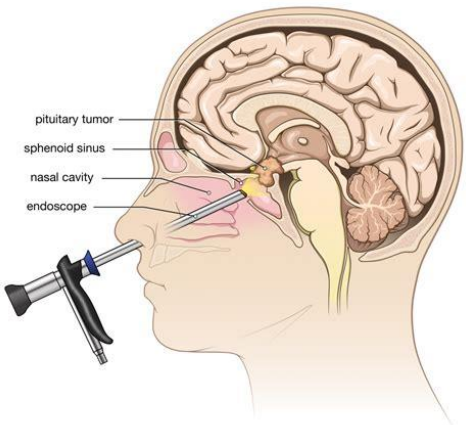
Hypopituitarism

- Hypopituitarism (pituitary insufficiency) = hyposecretion of one or more of the pituitary hormones
- **Etiology.**
- pituitary tumor
- radiation of a brain tumor
- complications following brain surgery
- Trauma
- Ischemia
- Infarction
- hemorrhage.



- Sheehan's syndrome = pituitary ischemia and infarction that develop after childbirth because of severe hemorrhage.
- Empty sella syndrome = a condition caused by compression of the pituitary gland by brain tissue herniation
- Panhypopituitarism = a rare disorder, is the complete loss of all the pituitary hormones.

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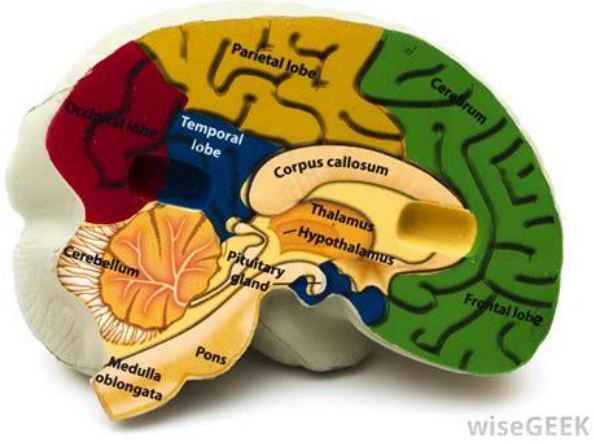
- Mrs. Ford is a 32 year old female who was admitted to the neuro ICU two days ago after a fall, which caused a large epidural hematoma over the left parietal lobe.

➢ *Worry about:*

- Damage to Pituitary and/or Hypothalamus glands:
- → can cause SIADH, DI, temperature regulation issues, as well as issues with CNS functions like breathing



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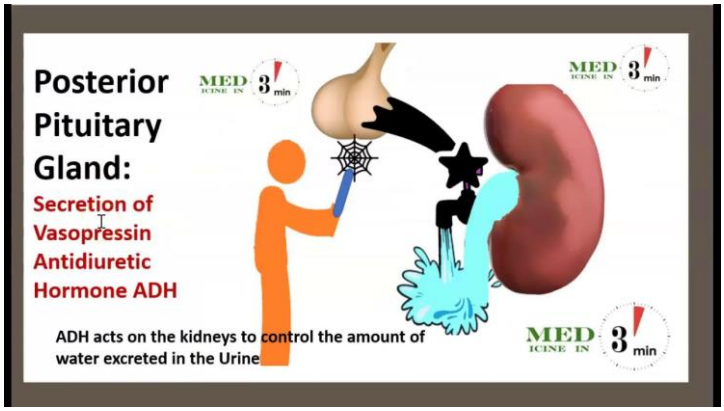
Diabetes Insipidus

- Two categories:
  - **central** → because of a lack of secretion of ADH from the posterior pituitary
  - **nephrogenic** --> when the kidney fails to respond to ADH.



***Etiology*:**

- Central:
  - tumors
  - head trauma (injury of the posterior pituitary or the hypothalamic–hypophyseal tract)
  - pituitary surgery
  - inflammatory disorders, infection, or exposure to chemical toxins.
- Nephrogenic:
  - nephrotoxic drugs (example: lithium)
  - obstructive uropathy
  - ischemia of the kidney,
  - hypokalemia, or hypocalcemia.

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Diabetes Insipidus

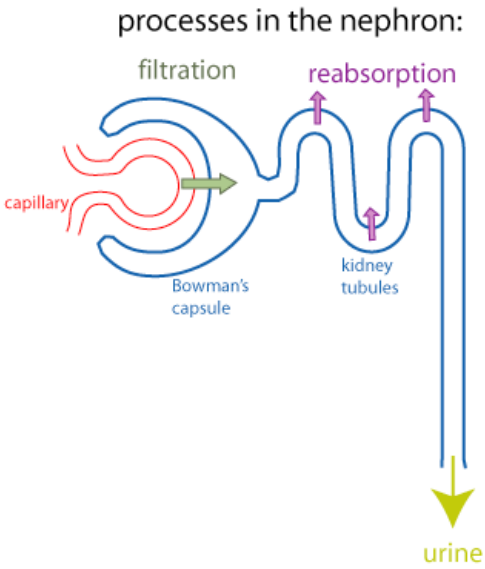
Pathophysiology.

- Whether there is decreased ADH secretion from the posterior pituitary gland or an insensitive ADH receptor in the kidney, the same pathophysiological process occurs.
- The nephron does not perform antidiuresis (the nephron does not reabsorb water from the tubule fluid)
- the body loses high amounts of water in the urine (bloodstream loses water) → polyuria, dilute urine, dehydration

S/S:

- because of dehydration → hypernatremia, polydipsia, confusion, disorientation, myoclonus, seizures, and, **coma** in severe cases

Treatment: **mainly** desmopressin or synthetic vasopressin.



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Hyperpituitarism

- primary hypersecretion of pituitary hormones
  - rare

Ethiology:

- adenomas → producing ACTH, TSH, or GH
- A GH-secreting pituitary adenoma is rare.
- 3 to 4 cases per million population per year in the United States.
  - In children, a GH-secreting tumor causes gigantism
  - in adults, it causes acromegaly.

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Thyroid Disorders

Hormones:

→ have a wide range of physiological effects.

- triiodothyronine (T3)
- thyroxine (T4)

Goiter

- Excess pituitary TSH
- Iodine deficiency

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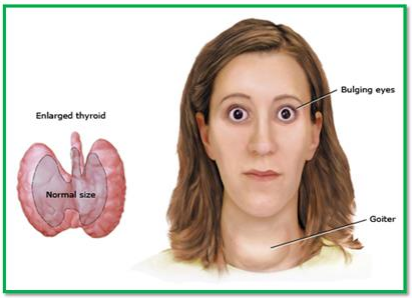
Hypothyroidism and Hyperthyrodism

Thyroid hormone affects the body's various metabolic activities, regulate many physiological processes

- **Hypothyroidism**
  - **Myxedema** = severe hypoth. in adult
  - **Cretinism** = result of thyroid **hormone deficiency** during embryonic development and early neonatal life

Hyperthyroidism

- risk for cardiac arrhythmias, such as atrial fibrillation, and the development of heart failure.
- **Exophthalmos**



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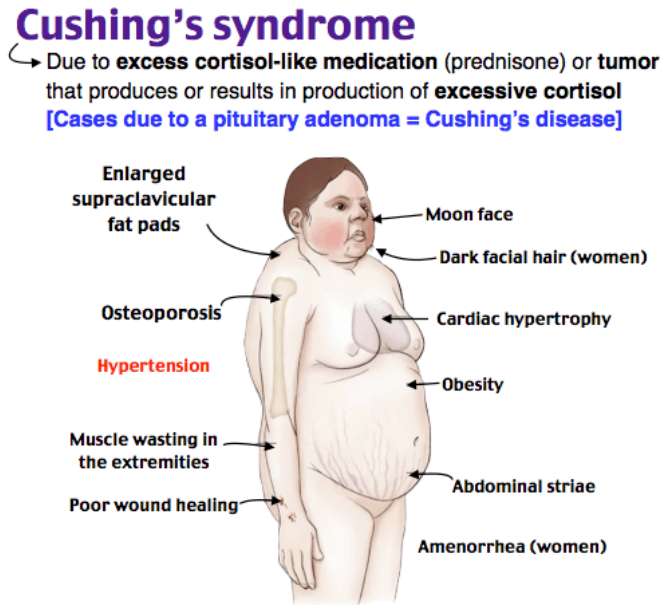
ADRENAL GLAND DISORDERS

CUSHING

- high levels of cortisol in the blood

- **Cushing's disease** = tumor of the pituitary gland that produces large amounts of ACTH
- results in excessive cortisol production.
- **Cushing's syndrome** = hyperadrenalism caused by a hyperactive adrenal gland that secretes excessive cortisol.
- Other causes of excessive cortisol:
  - certain cancers that secrete inappropriate ACTH
  - prolonged use of corticosteroid drugs such as prednisone or dexamethasone.



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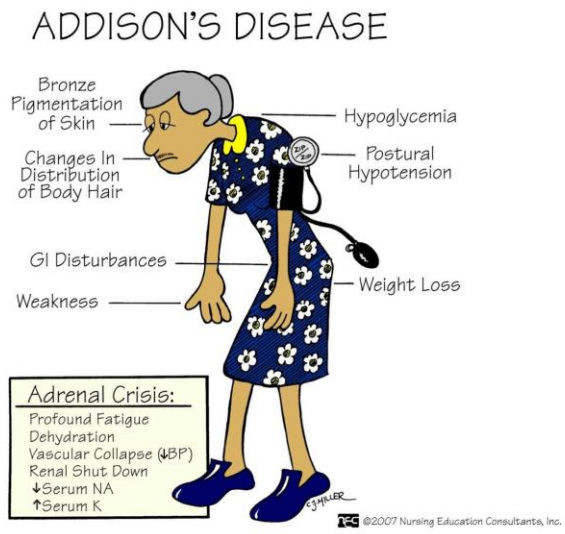
ADRENAL GLAND DISORDERS

ADDISON'S DISEASE

- decreased ACTH from the pituitary gland, or
- dysfunction of the adrenal gland, both of which cause decreased cortisol secretion.



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DIABETES MELLITUS

CHAPTER 25

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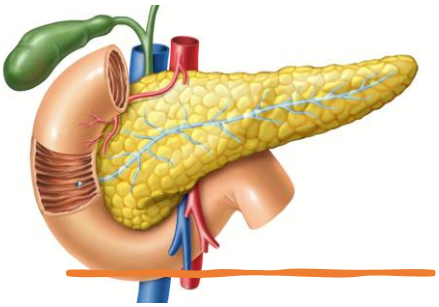
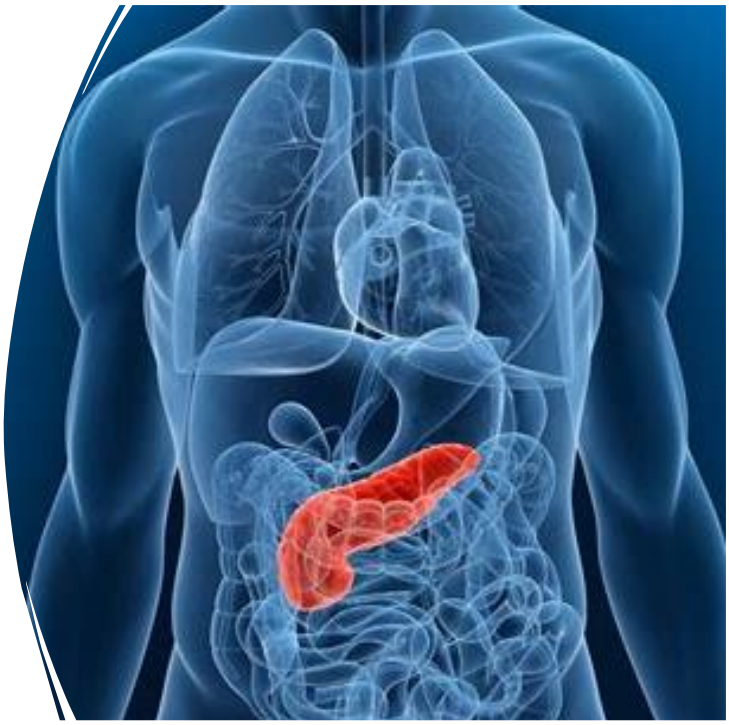


PANCREAS

- Exocrine gland
- Endocrine gland

➢ Secretes:

- enzymes to break down the foods we eat, and
- insulin and glucagon to control blood sugar



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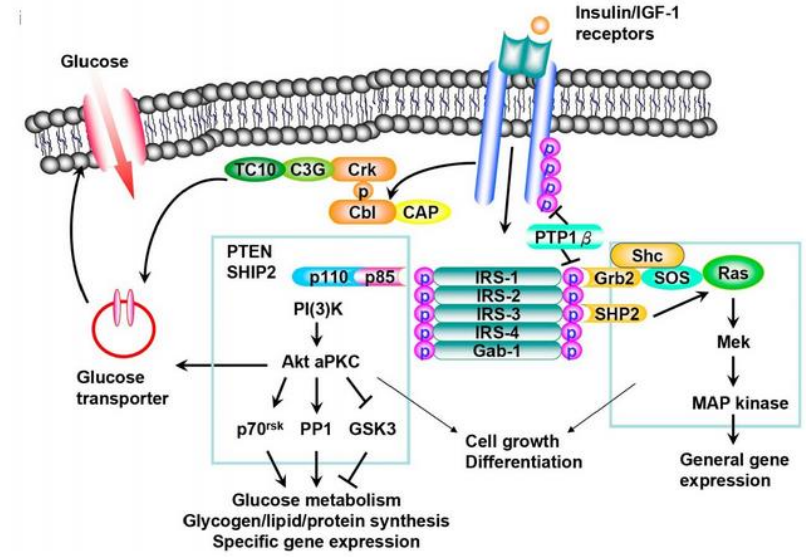
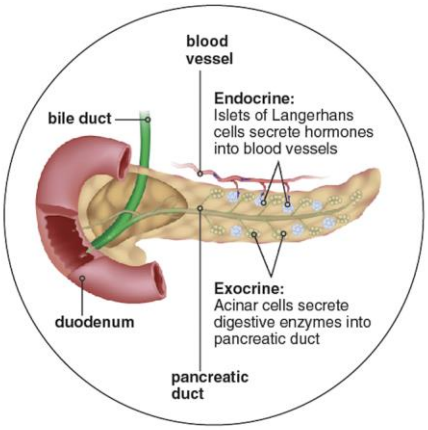
How would you explain the role of insulin on gene regulation as seen in the following image?





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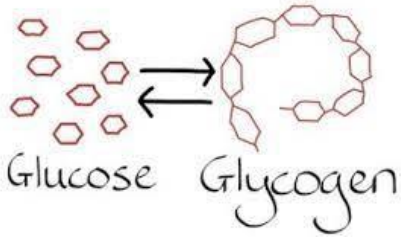

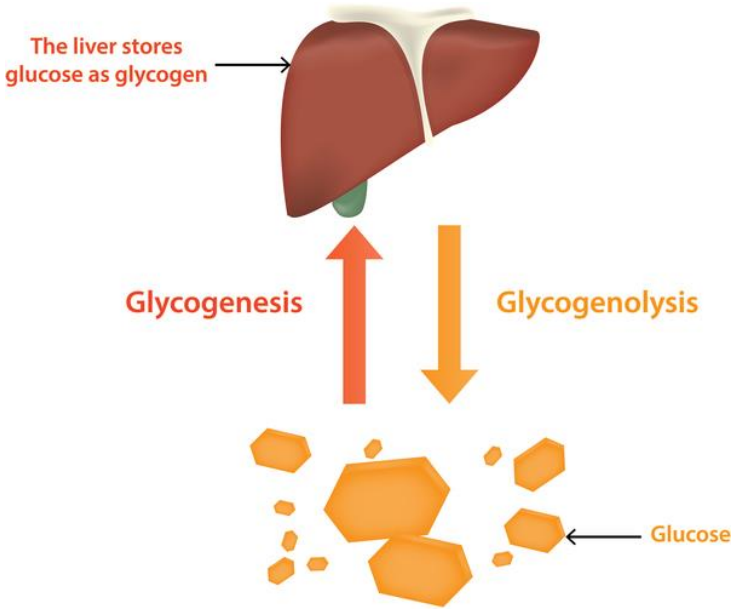

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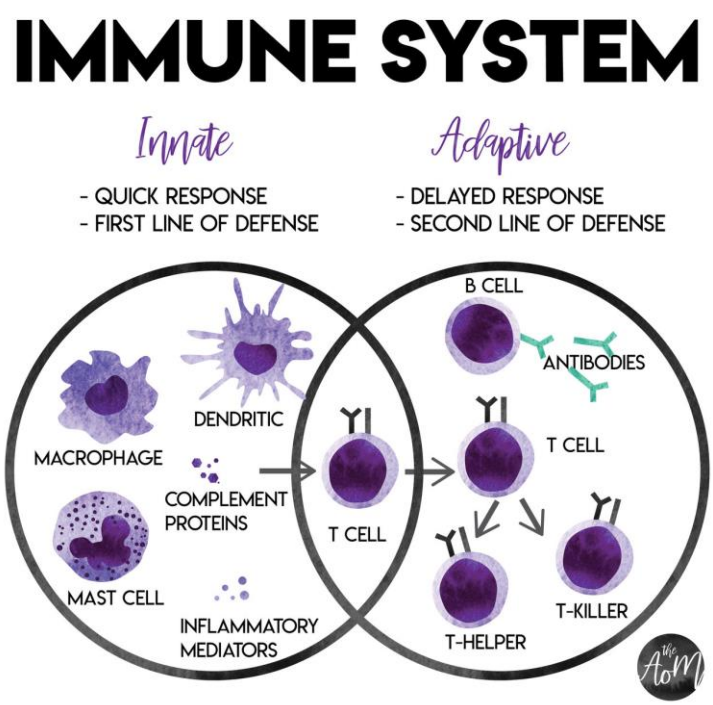

Diabetes I

Autoimmune

- (can be external or internal causes)

- adaptive immune system → ability to distinguish self from non-self.
- Every human cell has surface antigens called **major histocompatibility complexes (MHCs)**, also called human **leukocyte antigens (HLAs)**.
- NORMAL → The adaptive immune system allows the body to distinguish between antigens that belong to the host versus antigens that are from an invader.

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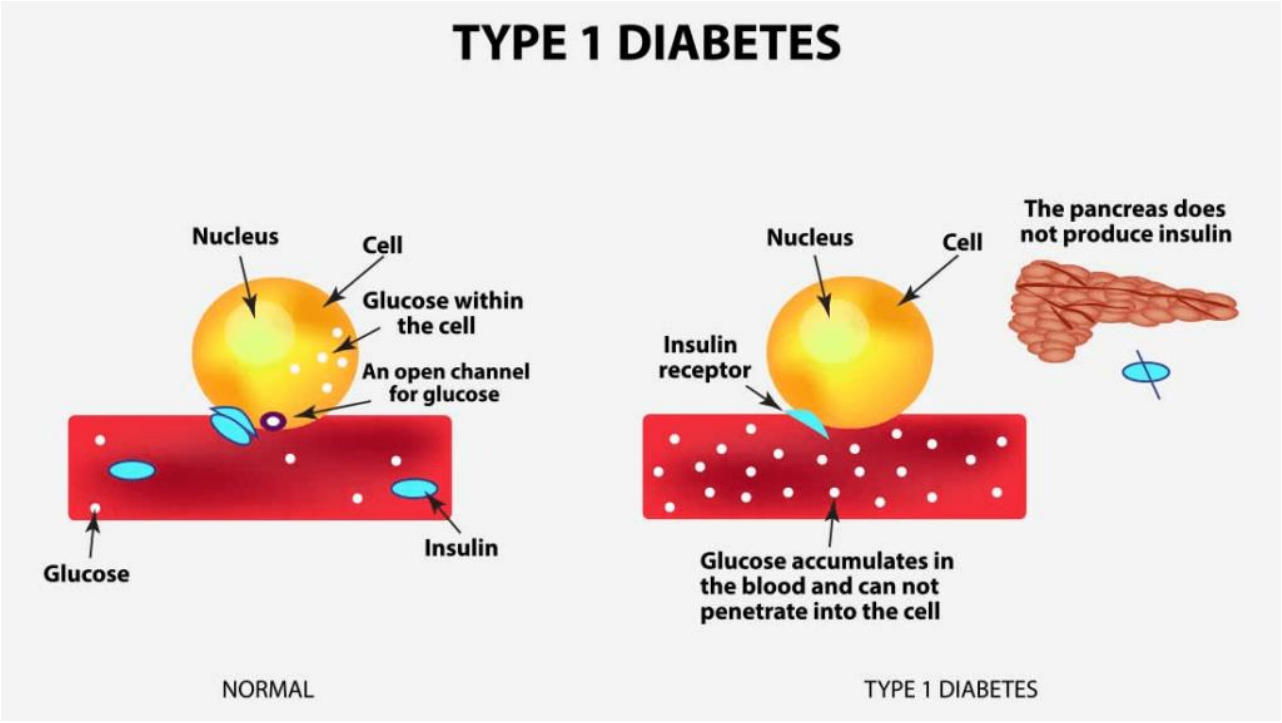

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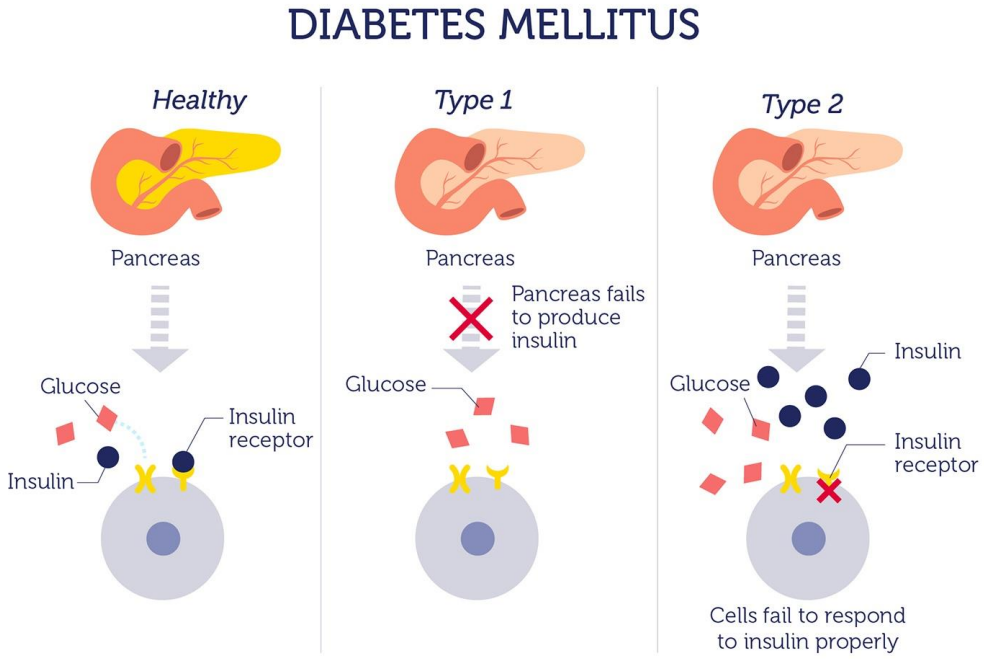

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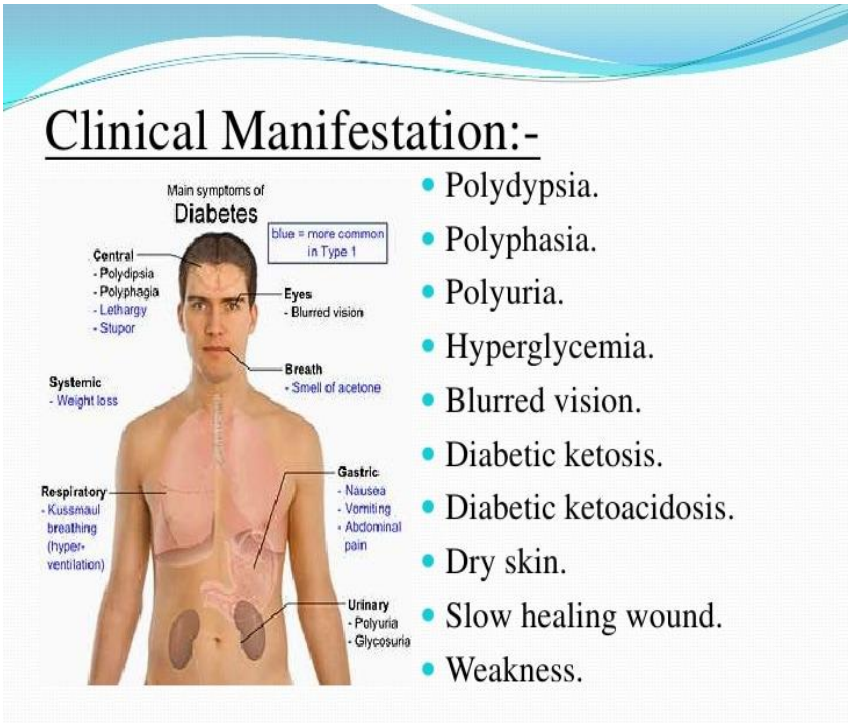
3 classic symptoms:

--polyuria

--polydipsia

--polyphagia



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EXCESSIVE URINATION VOLUME

Polyuria:
Urinate more than 2,500 milliliters or 2.5 liters on a daily basis.

Polyphagia

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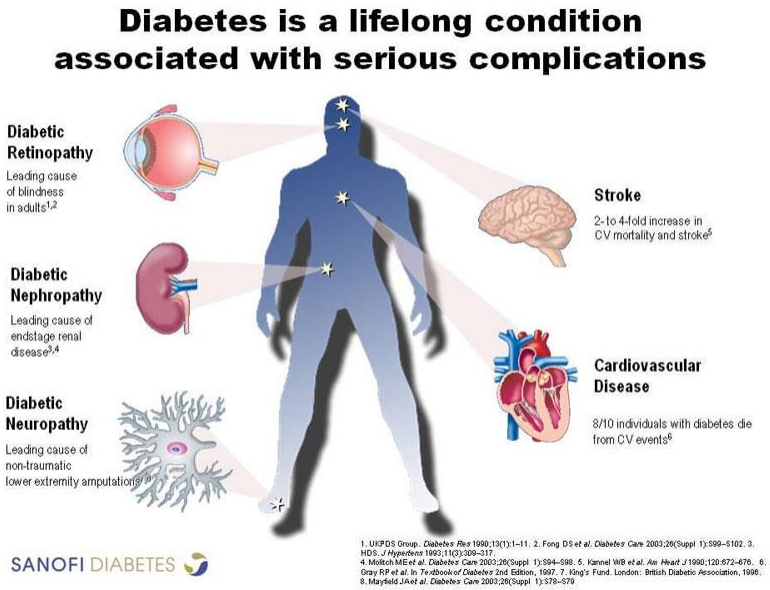
Complications

One of the most serious <u>acute</u> complications caused by severe hyperglycemia:

- DKA (mainly in T1DM - not common in T2DM)
- HHS (T2DM) → severe hyperglycemia usually causes **hyperosmolar hyperglycemic syndrome (HHS)** .
  - DKA and HHS → can be life-threatening disorders
- Hypoglycemia
- Long-term systemic complications (prolonged uncontrolled diabetes)



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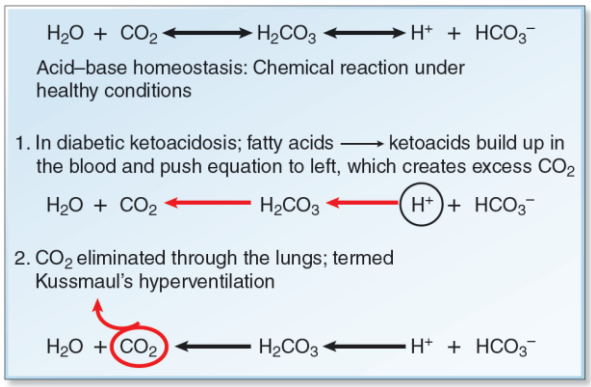
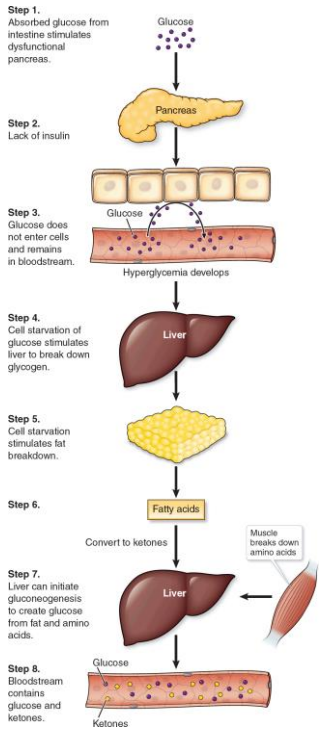
Diabetic Ketoacidosis

- Ketones are strong acids that accumulate in the blood, alter blood pH, and cause **metabolic acidosis**
- **S/S:** polyuria, polydipsia, polyphagia, weakness, abdominal pain, Kussmaul's respirations, nausea, and vomiting.





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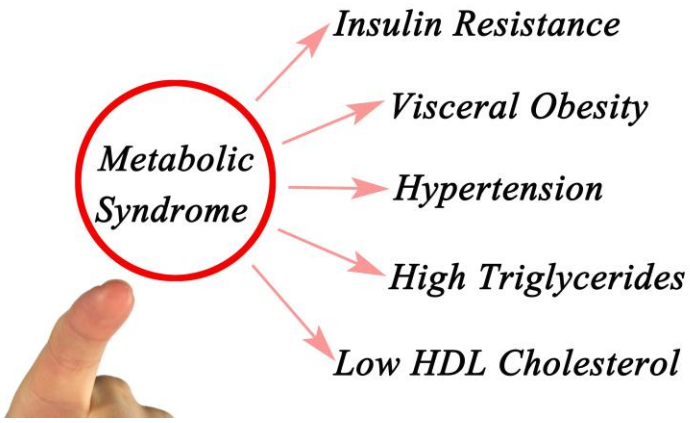
Metabolic syndrome

- hypertension, dyslipidemia, hyperinsulinism,
- centralized or "apple-shaped" obesity,
- glucose intolerance, and a predisposition to T2DM.
- Metabolic syndrome increases the risk of coronary artery disease and other diseases related to arteriosclerosis, such as stroke and peripheral vascular disease.



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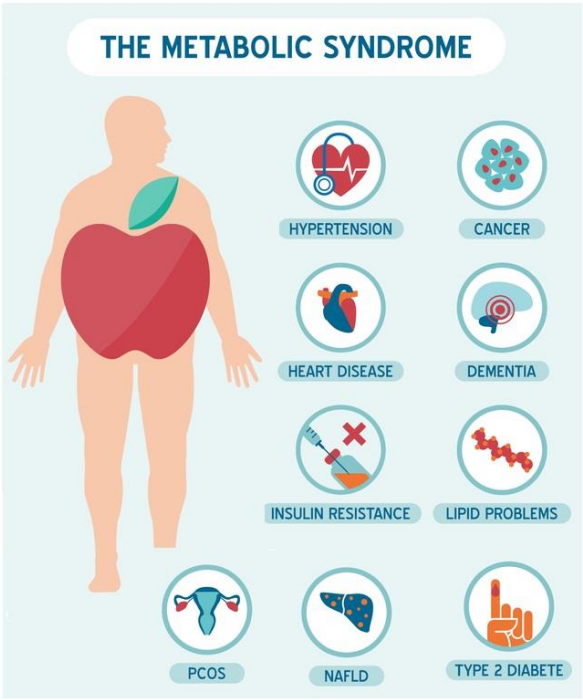
THE METABOLIC SYNDROME
HYPERTENSION
CANCER
HEART DISEASE
DEMENTIA
INSULIN RESISTANCE
LIPID PROBLEMS
PCOS
NAFLD
TYPE 2 DIABETE

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