<table>
<thead>
<tr>
<th>Endocrine gland</th>
<th>Hormone Released</th>
<th>Chemical Class</th>
<th>Target Tissues/Organs</th>
<th>Chief Function(s) of Hormones</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypothalamus</td>
<td>Hypothalamic-releasing and release-inhibiting hormones</td>
<td>Peptide</td>
<td>Anterior pituitary</td>
<td>Regulate anterior pituitary hormones</td>
</tr>
<tr>
<td>Posterior pituitary</td>
<td>Antidiuretic (ADH)</td>
<td>Peptide</td>
<td>Kidneys</td>
<td>Stimulates water reabsorption by kidneys</td>
</tr>
<tr>
<td></td>
<td>Oxytocin</td>
<td>Peptide</td>
<td>Uterus, mammary glands</td>
<td>Stimulates uterine muscle contraction release of milk by mammary glands</td>
</tr>
<tr>
<td>Anterior pituitary</td>
<td>Thyroid –stimulating (TSH)</td>
<td>Glycoprotein</td>
<td>Thyroid</td>
<td>Stimulates thyroid</td>
</tr>
<tr>
<td></td>
<td>Adrenocorticotropic (ACTH)</td>
<td>Peptide</td>
<td>Adrenal cortex</td>
<td>Stimulates adrenal cortex</td>
</tr>
<tr>
<td></td>
<td>Gonadotropic [follicle-stimulating (FSH), luteinzing (LH)]</td>
<td>Glycoprotein</td>
<td>Gondas</td>
<td>Egg and sperm production, and sex hormone production</td>
</tr>
<tr>
<td></td>
<td>Prolactin (PRL)</td>
<td>Protein</td>
<td>Mammary glands</td>
<td>Milk production</td>
</tr>
<tr>
<td></td>
<td>Growth (GH)</td>
<td>Protein</td>
<td>Soft tissues, bones</td>
<td>Cell division, protein synthesis, and bone growth</td>
</tr>
<tr>
<td></td>
<td>Melanocyte-stimulating (MSH)</td>
<td>Peptide</td>
<td>Melanocytes in skin</td>
<td>Unknown function in humans; regulates skin color in lower vertebrates</td>
</tr>
<tr>
<td>Thyroid</td>
<td>Thyroxine (T₄) and triiodothyronine (T₃)</td>
<td>Iodinated amino acid</td>
<td>All tissues</td>
<td>Increases metabolic rate; regulates growth and development</td>
</tr>
<tr>
<td></td>
<td>Calcitonin</td>
<td>Peptide</td>
<td>Bones, kidneys, intestine</td>
<td>Lowers blood calcium level</td>
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<tr>
<td>Parathyroids</td>
<td>Parathyroid (PTH)</td>
<td>Peptide</td>
<td>Bones, kidneys, intestine</td>
<td>Raises blood calcium level</td>
</tr>
<tr>
<td>Adrenal cortex</td>
<td>Glucocorticoids (cortisol)</td>
<td>Steroid</td>
<td>All tissues</td>
<td>Raise blood glucose level, prot. breakdown</td>
</tr>
<tr>
<td></td>
<td>Mineralocorticoids (aldosterone)</td>
<td>Steroid</td>
<td>Kidneys</td>
<td>Reabsorb sodium and excrete potassium</td>
</tr>
<tr>
<td></td>
<td>Sex hormones</td>
<td>Steroid</td>
<td>Gonads, skin, muscles, bones</td>
<td>Stimulate reproductive organs and bring about sex characteristics</td>
</tr>
<tr>
<td>Adrenal medulla</td>
<td>Epinephrine and norepinephrine</td>
<td>Modified amino acid</td>
<td>Cardiac and other muscles</td>
<td>Emergency situations; raise blood glucose level</td>
</tr>
<tr>
<td>Pancreas</td>
<td>Insulin</td>
<td>Protein</td>
<td>Liver, muscles, adipose tissue</td>
<td>Lowers blood glucose level; promotes formation of glycogen</td>
</tr>
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<td>Glucagon</td>
<td>Protein</td>
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<td>Raises blood glucose level</td>
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<td>Gonads</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Testes</td>
<td>Androgens (testosterone)</td>
<td>Steroid</td>
<td>Gonads, skin, muscles, bones</td>
<td>Stimulate secondary male sex characteristics</td>
</tr>
<tr>
<td>Ovaries</td>
<td>Estrogens and progesterone</td>
<td>Steroid</td>
<td>Gonads, skin, muscles, bones</td>
<td>Stimulate female sex characteristics</td>
</tr>
<tr>
<td>Thymus</td>
<td>Thymosins</td>
<td>Peptide</td>
<td>T lymphocytes</td>
<td>Production and maturation of T lymphocytes</td>
</tr>
<tr>
<td>Pineal gland</td>
<td>Melatonin</td>
<td>Modified amino acid</td>
<td>Brain</td>
<td>Circadian and circannual rythms; possibly involved in maturation of sex organs</td>
</tr>
</tbody>
</table>
What is a target cell?

Are the cells that have the receptor for the specific hormone

**Exocrine vs. endocrine glands**

**Exocrine glands** secrete their products into ducts that carry these products to other organs or outside the body

**Endocrine glands** secrete their products directly into the bloodstream
Action of peptide hormones

Eg. Epinephrine

2nd messenger system
All derived from Cholesterol, and contain 4 carbon rings. (Adrenal cortex, ovary, testis). Slow action but may last more time (they cause synthesis of proteins, while peptide Hs cause activation of already existing enzymes).

Thyroid action similar to steroid action (they are not steroid)
Major glands of the endocrine system

Hypothalamus
Posterior pituitary gland
Anterior pituitary gland
Thyroid gland
Parathyroid glands
Adrenal glands
Pancreas
Testes
Ovaries
Thymus gland
Pineal gland
اعوف الدنيا / محمد السالم

الدنيا اذا تمشى واصل اني
كل حظن لمنه لا تنساني
صعب اصير حبيبي لحظه ان
مثلك قوي بالحب واحب ثاني
اذ رايح اخذ روحى لتخلينى
بجيش خصني من نوحى ومن احزاني
حياتى وانته مو يمي
متعبنى
حتى الراحه بغيابك تعذني
مو سهله عليه مفارق عيونك
مو صعبه عندك من تفاركى
1. Hypothalamus

Regulates internal environment through the autonomic nervous system and the control of the secretion of pituitary hormones

- Helps control heartbeat
- Helps control body temperature
- Helps control water balance
- Controls glandular secretions

2. Posterior pituitary gland

Stores antidiuretic hormone (ADH) and oxytocin that are produced by the hypothalamus

- **ADH**: regulates water balance by reabsorbing water into the bloodstream (deficiency of this hormone causes Diabetes Insipidus)
- **Oxytocin**: causes uterine contractions during childbirth and allow milk to be released during breast feeding.
Anterior pituitary gland

Controlled by hypothalamic-releasing and hypothalamic-inhibiting hormones (e.g. TIH, TRH)

Hormones produced by the anterior pituitary:
- **Thyroid-stimulating hormone (TSH):** stimulates the thyroid to produce thyroid hormones
- **Adrenocorticotropic hormone (ACTH):** stimulates the adrenal cortex to produce cortisol
- **Gonadotropic hormones:** stimulate gonads to produce sex cells and hormones
- **Prolactin (PRL):** stimulates mammary glands to develop and produce milk only after childbirth
- **Melanocyte-stimulating hormone (MSH):** causes skin cells to produce melanin
- **Growth hormone (GH):** promotes growth and stimulate liver to produce IGF (Insulin-like growth factor).
The hypothalamus and pituitary


2. These hormones are secreted into a portal system.

3. Each type of hypothalamic hormone either stimulates or inhibits production and secretion of an anterior pituitary hormone.

4. The anterior pituitary secretes its hormones into the bloodstream, which delivers them to specific cells, tissues, and glands.
Pituitary dwarfism – too little GH is produced during childhood that results in small stature

Giantism – too much GH is produced during childhood that results in poor health

Acromegaly – overproduction of GH in adult that results in larger than normal feet, hands, and face (bones not get longer but thicker or wider)
**Thyroid gland**

A large gland located below the larynx. Composed of follicles filled with T3 and T4.

**Iodine** is needed in the diet to allow the thyroid gland to produce its hormones. Iodine deficiency causes Simple Goiter.

It produces:

- **Thyroid hormone (TH, as T3 and T4):** regulates metabolism of all the body tissues
- **Calcitonin:** helps lowering blood $\text{Ca}^{2+}$ levels by
  1. stimulating the deposition of calcium in the bones by **osteoblasts**
  2. reducing the activity of the **osteoclast** cells
Thyroid abnormalities

Simple goiter – thyroid enlarges due to lack of iodine in the diet

Hypothyroidism – low blood levels of thyroid hormones

  Congenital hypothyroidism: thyroid does not develop properly and is characterized in a short, confused person that may be mentally retarded (Cretinism)

  Myxedema: hypothyroidism in adults characterized by lethargy (lack of energy), weight gain, loss of hair, cold intolerant and thick, puffy skin

Hyperthyroidism – excess thyroid hormones in the blood

  Exophthalimic goiter: such as seen in Graves' disease and is characterized by enlargement of the thyroid gland, protrusion of the eyes, hyperactive and suffers from insomnia

  Thyroid tumor: can also cause hyperthyroidism (treatments)
Hyperthyroidism is characterized by an increased metabolic rate, weight loss, and nervousness. The eyes may also produce (exophthalmos), as in this photograph.
Parathyroid glands

Small glands embedded in the surface of the thyroid gland

Produces parathyroid hormone (PTH):
- causes blood Ca\(^{2+}\) level to increase by promoting osteoclast activity
- PTH promotes reabsorption of Ca\(^{2+}\) by the kidneys. (The kidney activates Vit D/Calcitriol which activates the Intestine to reabsorb Ca.)

Hypoparathyroidism- Low Ca levels and Tetany.
6. Adrenal glands

Glands that sit on top of the kidneys

2 parts of each gland
  Adrenal medulla: controlled by the nervous system
  Adrenal cortex: portions are controlled by ACTH from the anterior pituitary

Adrenal medulla

Inner portion of the adrenal glands

Hypothalamus initiates stimulation of hormone secretion in the adrenal medulla

Produces: hormones that allow a short-term response to stress ("fight or flight" response)
  Epinephrine (adrenaline)
  Norepinephrine
Adrenal cortex

Outer portion of the adrenal glands

Produces hormones that provide a long-term response to stress

2 major types of hormones:

Mineralocorticoids:
  regulate salt and water balance (Release is stimulated by AngII)
  e.g. aldosterone (targets the kidney) (Role in BP of ADH, ANH)

Glucocorticoids:
  regulate carbohydrate, protein and fat metabolism
  Suppress the body’s inflammatory response
  e.g. cortisol and cortisone

Other types of hormones secreted by the adrenal cortex are the sex hormones (small amounts, of both sexes hormones)
GCs increase blood glucose by promoting protein breakdown, making amino acids which are converted into glucose by the liver. They also promote the metabolism of fatty acids rather than glucose.

### Stress Response: Short Term
- Heartbeat and blood pressure increase.
- Blood glucose level rises.
- Muscles become energized.

### Stress Response: Long Term

#### Glucocorticoids
- Protein and fat metabolism instead of glucose breakdown.
- Reduction of inflammation; immune cells are suppressed.

#### Mineralocorticoids
- Sodium ions and water are reabsorbed by the kidney.
- Blood volume and pressure increase.
Adrenal glands malfunction

Addison’s disease – hyposecretion of glucocorticoids by the adrenal cortex characterized by bronzing of the skin, unable to cope with stress. Hyposecretion of Aldosterone leads into dehydration, Na loss.

Bronzing of the skin is due to elevated levels of ACTH (loss of negative feedback). ACTH has similar structure to MSH which stimulates the release of melanin.
Cushing syndrome – hypersecretion of glucocorticoids by the adrenal cortex characterized by weight gain in the trunk of the body but not arms and legs. Tendency to DM. Sometimes *Masculinization*, High BP. Fat mobilization from periphery into midline sections.

**Endocrine diseases:**

**Growth Hormone:** Dwarfism (low GH in childhood), Giantism (High GH since childhood), Acromegally (High GH in adulthood)

**Thyroid:** Cretinism (congenital hypothyroidism), Myxedema (adult hypothyroidism), Hyperthyroidism (Grave’s disease/ exophthalmic hyperthyroidism)

**Adrenal gland:** Addison’s disease (Hyposecretion of glucocorticoid/ aldosterone), Cushing syndrome: (Hypersecretion)
7. Pancreas

Fish-shaped organ behind the stomach
Composed of 2 tissues:
**Exocrine**: produces and secretes digestive juices
**Endocrine** (islets of Langerhans): produces and secretes hormones
  - **Insulin** – secreted when blood glucose is high and stimulates uptake of glucose by cells (muscle and liver)
  - **Glucagon** – secreted when blood glucose is low and stimulates the breakdown of glycogen in the liver
Thymus gland

- Lies beneath the sternum
- This gland is largest and most active during childhood
- T lymphocytes mature here
- Secretes hormones called thymosin that aid in differentiation of lymphocytes

Pineal gland

Located in the brain
Secretes melatonin that regulates the sleep/wake cycle (circadian rhythm)
May also regulate sexual development
Hormones from other tissues

**Erythropoietin**: secreted by the kidney to increase red blood cell production

**Leptin**: produced by fat cells and acts on the hypothalamus to give a feeling of being satiated

**Prostaglandins:**
- A group of potent chemicals that are not carried in the bloodstream but work locally on neighboring cells
- Some cause smooth muscle contraction
- Major impact on reproductive organs
- Many other roles in the body
- Aspirin and ibuprofen block the synthesis
The fatal Mistake of a Genius