

## THE ENDOCRINE SYSTEM – PRELIM ACTIVITY

HORMONES AT LARGE- Guy meets Gal and the rest is ....Hormonal????



WHAT DO YOU THINK THEY ARE SAYING/DOING?



WHAT DOES THIS SYMBOL MEAN TO YOU?



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shutterstock - 66098632 WHAT DOES THIS SYMBOL MEAN TO YOU?



WHAT DOES THIS SYMBOL MEAN TO YOU?



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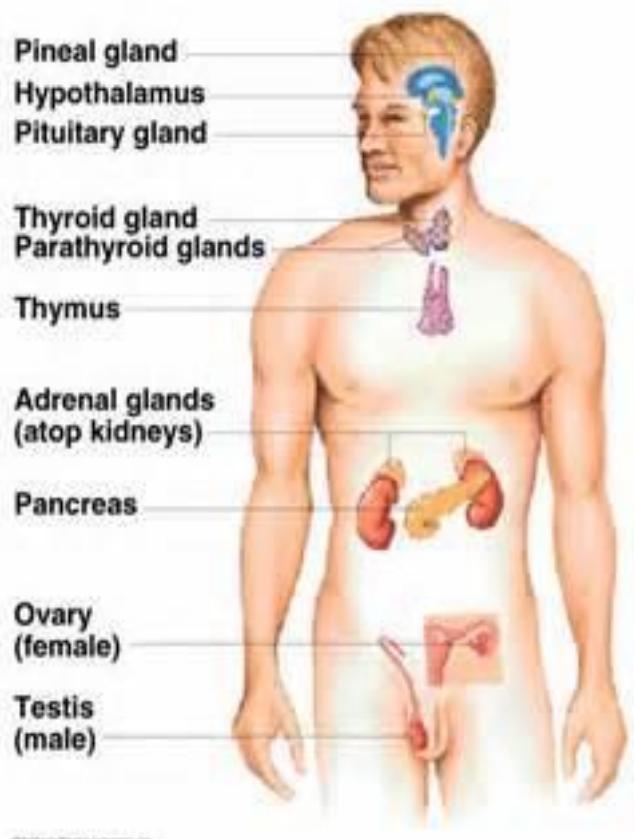


WHAT DOES THIS SYMBOL MEAN TO YOU?

# **THE ENDOCRINE SYSTEM**

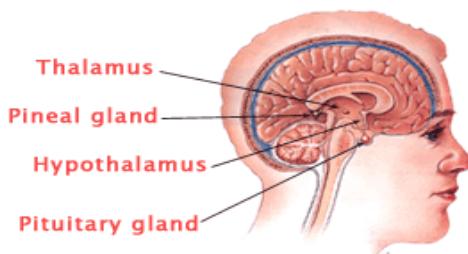
A. The **Endocrine system** is one of the body's main systems for communicating, controlling, and regulating the body's needs and functions through chemical messages and signals called **HORMONES**. These hormones are produced by a system of glands located throughout our body. They are crucial in the regulating process of the entire body, yet comprise less than 3 pounds of our body weight.

## **GLANDS OF THE ENDOCRINE SYSTEM**



B. **Role of Hormones** – Hormones travel throughout the body coordinating complex processes like growth, metabolism, fertility, the immune system, behavior, birthing, development, growth proportioning of the body's regions and limbs, stimulate and guide puberty, digestion and many more functions.

## **C. GLANDS IN THE BRAIN**



**1. HYPOTHALAMUS GLAND** Lies above the pituitary gland. It controls all means of production and allows the hormones to start and stop in the pituitary glands, through "releasing hormones" such as:

1. Growth hormones (GH),
2. Thyrotroph,
3. Thyrotropin-releasing hormone (TRH),
4. Corticotropin (CHR), Gonadotropin (GnRH),
5. Lutenizing hormone (LH),
6. Follicle-stimulating hormone (FSH).

## **2. PITUITARY GLAND**

Known as the "master gland" because its hormones regulate so many functions. However, it obeys the commands of the hypothalamus gland. It is divided into two parts:

A, ANTERIOR PITUITARY-- produces :

1. Prolactin,
2. Growth Hormone,
3. Adrenocorticotropin (ACTH),
4. Thyroid-stimulating hormone (TSH),
5. Lutenizing (LH),
6. Follicle-Stimulating hormone (FSH).

B. POSTERIOR PITUITARY—produces

1. Oxytocin (milk letdown and contractions)
2. Antidiuretic hormone (water balance regulation).

## **3. PINEAL GLAND**

It is a small mass of tissue near the mammalian brain. It secretes the hormone melatonin (which regulates functions related to light as well as other biological rhythms). It also stops the action of gonadotropin, which cause the testes and ovaries to develop and function.

## **D. GLANDS OF THE LOWER BODY**

**1. THYROID GLAND** It is located inside the frontal neck. It controls metabolism, helps break down food, and releases the hormones :

- A. tri-iodothyronine (T3)
- B. thyroxine (T4).

**2. PARATHYROID GLAND**- It is located between the thyroid gland. Hormones from this gland control calcium and phosphorus levels and bone development.

**3. THYMUS GLAND** This gland is needed in the early stage of life, engaging the development of the immune system- lymphoid system as it is here that the T-Cells (scouts) of the immune system develop.

**4. ADRENAL GLANDS** - Each person has two adrenal glands—one located on top of each of the body's two kidneys. These glands are important to the body's endocrine (hormonal) system. Each adrenal gland has two main parts that function separately:

**A. Adrenal cortex.** produces **{Glucocorticoids}** (which helps with blood sugar, burn of protein and fat, and fever response) and **Mineralcorticoids** (controls blood volume, blood pressure, and produces sex hormones). The adrenal cortex also produces the hormones: **cortisol**, **aldosterone**, and **dehydroepiandrosterone (DHEA)**. These hormones carefully control metabolism and body characteristics, such as hair growth and body shape.

**B. Adrenal medulla.** produces **adrenaline** which controls heart rate, improves oxygen airways, blood flow to the muscles, and is typically active when a person is scared, excited, or under stress. The gland's inner part is called the medulla. The adrenal medulla also produces other hormones: **epinephrine**, **norepinephrine**, and **dopamine**. These hormones control the body's responses to stress, including the "fight or flight" adrenaline surge.

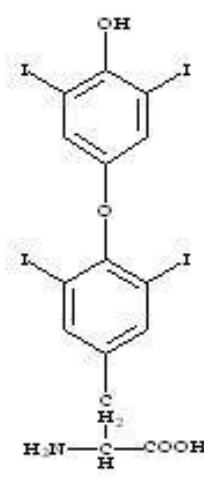
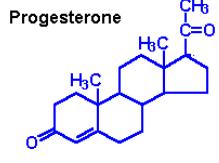
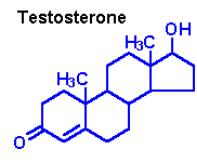
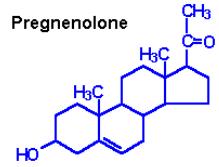
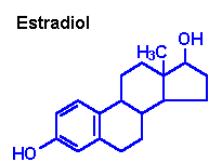
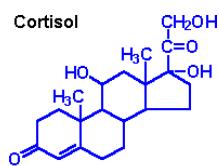
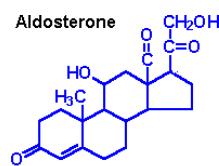
**5. PANCREAS** It is located behind the stomach. It helps you maintain a healthy blood sugar and secretes **insulin** (which helps glucose move from the blood).

## **6. REPRODUCTIVE GLANDS-** differing in males and females.

**A. TESTES** – They are the male reproductive glands. They secrete the hormone **testosterone** which control sex traits, the development of the penis, pubic hair, voice pitch and muscle development.

**B. OVARIES** Reproductive glands of females which produce **estrogen** and **progesterone**. They also maintain pregnancy, the menstrual cycle, and egg development and release every 28 days. When the body ceases this **menstrual cycle** they enter **menopause**.

STRUCTURAL FORMULAS of important steroid hormones (left) and thyroid hormones (right)



**E. THE ENDOCRINE HORMONE PROCESS** To achieve effective communication the endocrine system works with: the nervous system, reproductive system, kidneys, gut, liver, pancreas, and fat in an effort to regulate the body/

## THE ENDOCRINE SYSTEM- A NEGATIVE FEEDBACK SYSTEM –

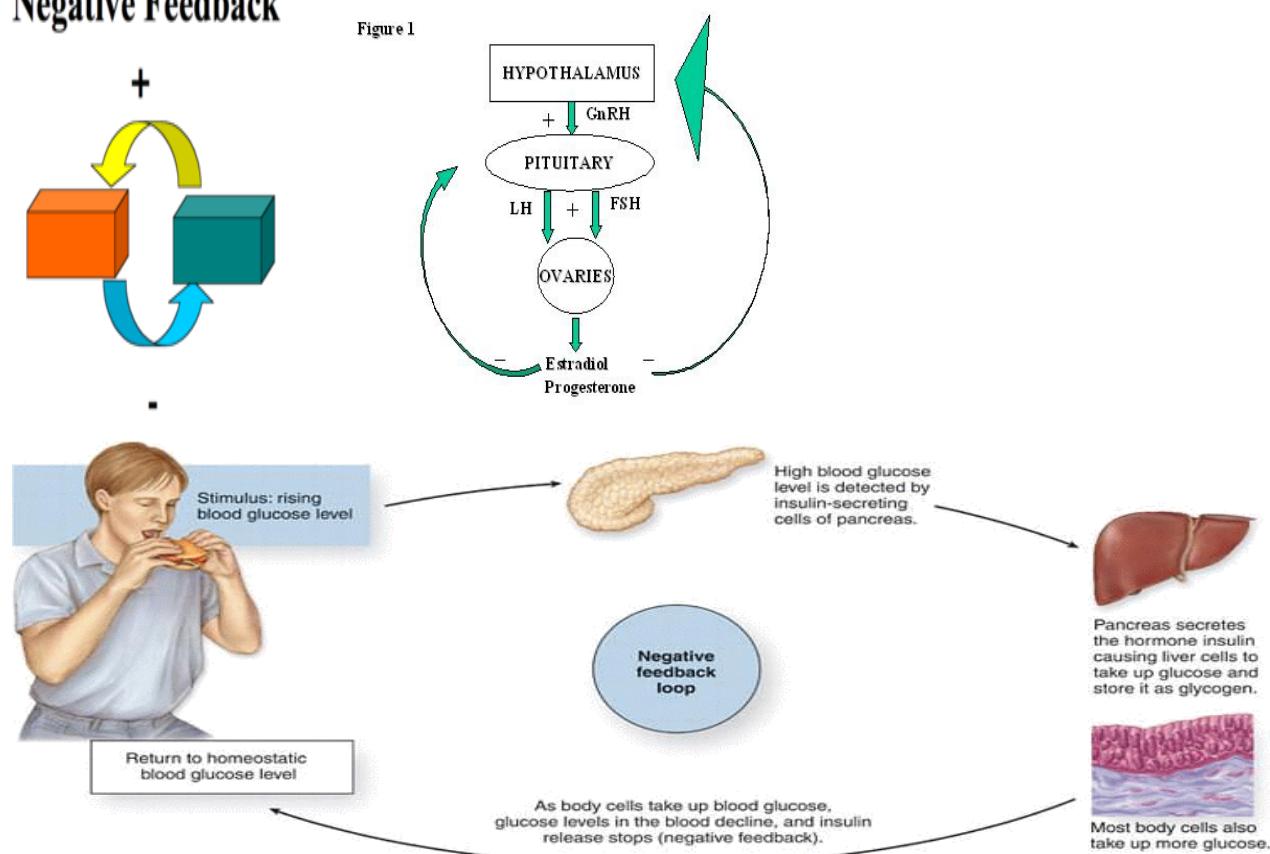
YOU TUBE VIEW:Positive and Negative Feedback Mechanisms (Physiology) .....1:11

THINK COLD WATER .....HOT WATER.... REGULATION ON A FAUCET

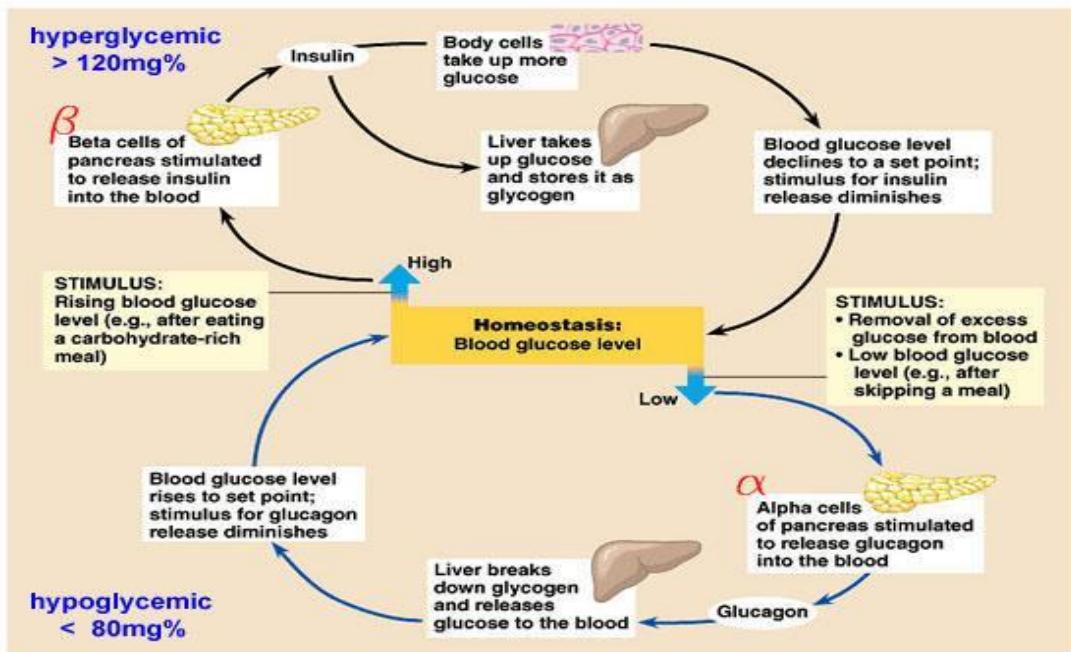
One distinctive feature of hormones whose secretion is regulated through the hypothalamus and pituitary is that they regulate their own secretion through **negative feedback inhibition**. What this means is that a hormone from a peripheral gland, for example, **cortisol**, binds to its receptor on cells in the hypothalamus and adenohypophysis, and has the effect of inhibiting secretion of **tropic hormones**: in this case, **CRH (corticotropin releasing hormone)** and **ACTH (adrenocorticotropic hormone)**. Less CRH secretion leads to less ACTH secretion, which leads to less stimulation of cortisol secretion by cells of the **zona fasciculata** of the **adrenal cortex**.

The usefulness of negative feedback inhibition is that it results in "**hormonal homeostasis**", that is the maintenance of hormone levels within a particular appropriate physiological range. Consider a case where one adrenal gland is damaged. This will cause decreased secretion of cortisol, and there will be a decrease in the degree of negative feedback inhibition on the hypothalamus and anterior pituitary. The release from negative feedback inhibition means that more CRH and ACTH will be secreted. More ACTH will stimulate the remaining adrenal tissue to grow and to secrete more cortisol. This will have the effect of bringing cortisol back up towards its normal daily level of secretion.

## Negative Feedback



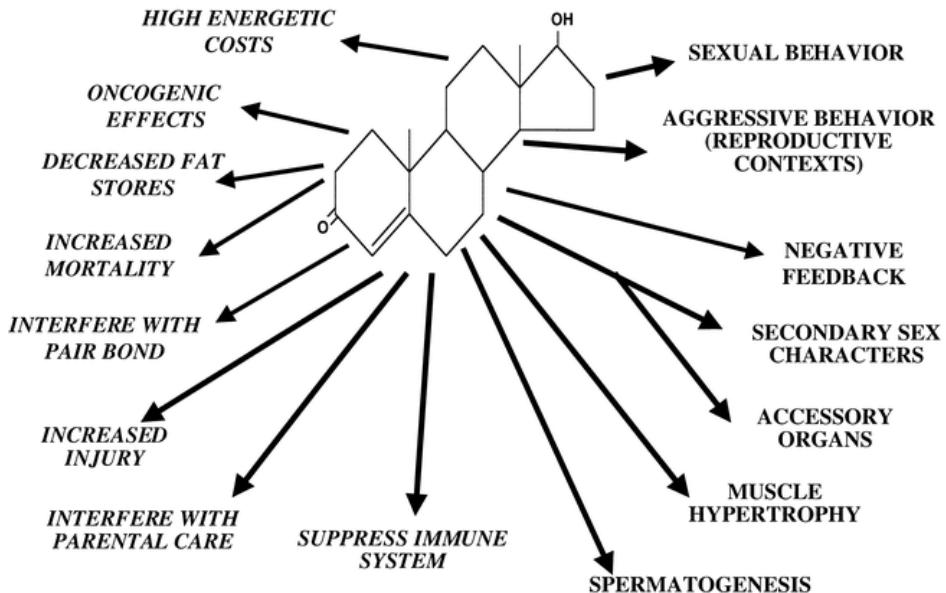
Glucose regulation and cycle (Homeostasis) (top) and a diagram on hormones entering the cell membrane (bottom)



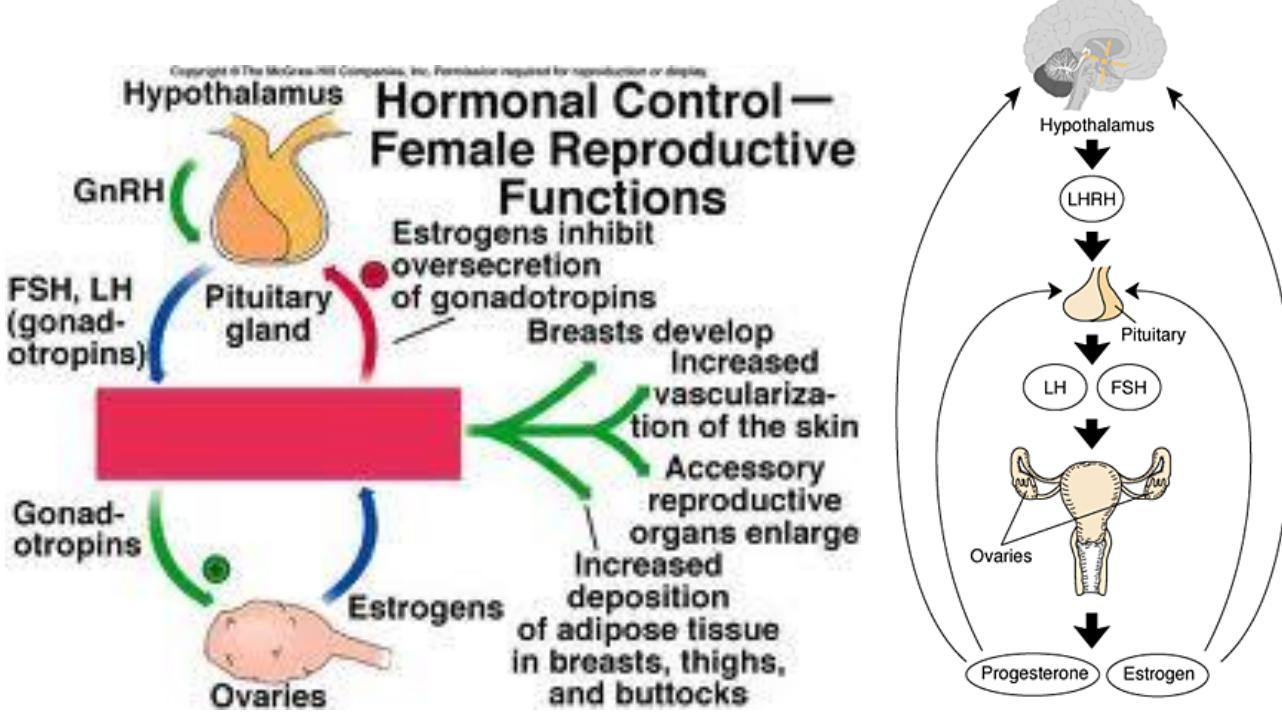
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## Testosterone? THE MALE BASED “ADJUSTABLE WRENCH” HORMONE.

# TESTOSTERONE



FEMALE HORMONES- The Chemical Cavalcade ! Give’em a break guys !



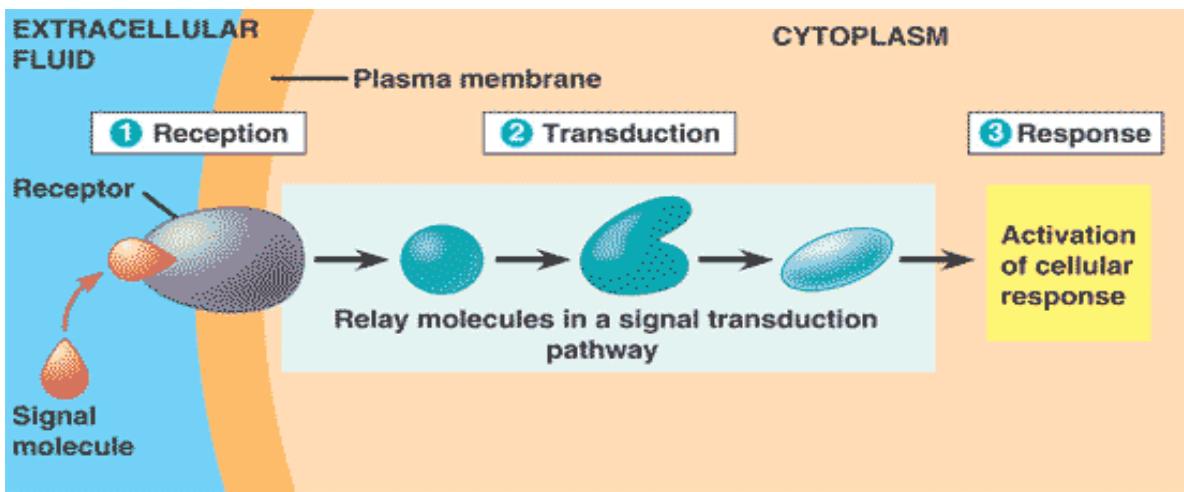
## 1. TYPES OF REGULATORS

- A. **GROWTH FACTORS:** Are peptides and proteins that stimulate cell proliferation. They have several kinds of target cells and functions and can enhance the strength of synapses between neurons in the brain.
- B. **NITRIC OXIDE:** Many cells produce this highly toxic and reactive substance which works as a **NEUROTRANSMITTER**. Is secreted by white blood cells and kills bacteria and cancer cells, and may promote muscles relaxation ( retraction)
- C **PROSTAGLANDINS (PGs):** Are modified fatty acids which stimulate contraction of the smooth muscles int he wall of the uterus and assist in defense mechanisms.

## 2. SENDING THE MESSAGE

Hormones secreted by its many glands are deposited in and move through the blood, transporting them as they arrive at a target organ which contains the appropriate receptor. The signal from the hormone binds to a specific protein (which can either be in the plasma membrane or inside the cell nucleus). If the cell has the right receptor for a particular signal, this will trigger a response, or change the behavior of the cell. This is known as **SIGNAL TRANSDUCTION**. When a series of these molecular changes convert to extracellular chemical signals to a specific cellular response, this is known as the **SIGNAL TRANSDUCTION PATHWAY**. Most hormones have plasma membrane receptors, but some hormones, such as steroid and thyroid regulators, enter in the cell.

If the receptor IS inside the cell nucleus, it will transcribe the message or change the gene expression. The hormone-receptor complex grabs on to specific places in the DNA that either stimulates it, or represses it. The newly packaged mRNA is then translated into a new protein in the cytoplasm.



### 3. HORMONAL RESULTS

When hormones successfully are successfully delivered to the targeted/appropriate areas of the body, the following should be reaching a homeostatic state:

- A. Body energy levels,
- B. reproduction, \
- C. growth and development,
- D. homeostasis (internal balance of body systems),
- E. proper responses to surroundings,
- F. stress,
- G. injury.

### 4. FACTORS WHICH MAY AFFECT THE ENDOCRINE SYSTEM

**A. AGING**-Alters hormone production and secretion, metabolism, blood levels, biological activities, target cell response, and bodily rhythms.

**B. ILLNESS** - Affects the kidney and liver (which play important roles throughout the endo-system) and may cause chronic heart and disorders in the kidney and liver.

**C. STRESS**- Adrenal glands MUST produce cortisol. If they don't, this may cause: trauma, severe illness or infection, intense heat or chill, disease, etc.

**D. ENVIRONMENTAL ENDOCRINE DISRUPTOR**- This can mimic natural hormone binding at target cell receptors, and block cellular events associated with hormone binding. This can later disrupt sex development, decrease fertility, defect birth, reduce immune response, etc.

**E. GENETICS**- Any missing, extra, altered, or damaged chromosomes can result in diseases or conditions related to hormones.

#### F. CYCLES OF HORMONE RELEASE

Time affects the release of certain hormones. For example-**Cortisol** builds up early in the day, decreases towards the evening, rises in sleep, and peaks in the early morning. Another example--**growth hormones** rise 90 minutes after sleep and during the first two hours of a deep sleep. It also increases if one has low blood sugar, starving, exercising, excited, or suffers from severe injury. And the menstrual cycle occurs every 28 days

**Table 11.1 | A Partial Listing of the Endocrine Glands**

Endocrine Gland	Major Hormones	Primary Target Organs	Primary Effects
Adipose tissue	Leptin	Hypothalamus	Suppresses appetite
Adrenal cortex	Glucocorticoids Aldosterone	Liver and muscles Kidneys	Glucocorticoids influence glucose metabolism; aldosterone promotes $\text{Na}^+$ retention, $\text{K}^+$ excretion
Adrenal medulla	Epinephrine	Heart, bronchioles, and blood vessels	Causes adrenergic stimulation
Heart	Atrial natriuretic hormone	Kidneys	Promotes excretion of $\text{Na}^+$ in the urine
Hypothalamus	Releasing and inhibiting hormones	Anterior pituitary	Regulates secretion of anterior pituitary hormones
Small intestine	Secretin and cholecystokinin	Stomach, liver, and pancreas	Inhibits gastric motility and stimulates bile and pancreatic juice secretion
Islets of Langerhans (pancreas)	Insulin Glucagon	Many organs Liver and adipose tissue	Insulin promotes cellular uptake of glucose and formation of glycogen and fat; glucagon stimulates hydrolysis of glycogen and fat
Kidneys	Erythropoietin	Bone marrow	Stimulates red blood cell production
Liver	Somatomedins	Cartilage	Stimulates cell division and growth
Ovaries	Estradiol-17 $\beta$ and progesterone	Female reproductive tract and mammary glands	Maintains structure of reproductive tract and promotes secondary sex characteristics
Parathyroid glands	Parathyroid hormone	Bone, small intestine, and kidneys	Increases $\text{Ca}^{2+}$ concentration in blood
Pineal gland	Melatonin	Hypothalamus and anterior pituitary	Affects secretion of gonadotrophic hormones
Pituitary, anterior	Trophic hormones	Endocrine glands and other organs	Stimulates growth and development of target organs; stimulates secretion of other hormones
Pituitary, posterior	Antidiuretic hormone Oxytocin	Kidneys and blood vessels Uterus and mammary glands	Antidiuretic hormone promotes water retention and vasoconstriction; oxytocin stimulates contraction of uterus and mammary secretory units
Skin	1,25-Dihydroxyvitamin D <sub>3</sub>	Small intestine	Stimulates absorption of $\text{Ca}^{2+}$
Stomach	Gastrin	Stomach	Stimulates acid secretion
Testes	Testosterone	Prostate, seminal vesicles, and other organs	Stimulates secondary sexual development
Thymus	Thymopoietin	Lymph nodes	Stimulates white blood cell production
Thyroid gland	Thyroxine (T <sub>4</sub> ) and triiodothyronine (T <sub>3</sub> ); calcitonin	Most organs	Thyroxine and triiodothyronine promote growth and development and stimulate basal rate of cell respiration (basal metabolic rate or BMR); calcitonin may participate in the regulation of blood $\text{Ca}^{2+}$ levels

# **ENDOCRINE SYSTEM – VIDEO TUTORIAL AND HOMEWORK**

Assignment: View the following video and take DETAILED notes. This will require that you pause the video several times.

**Great Glands--Your Endocrine System: CrashCourse Biology #33**

<http://www.youtube.com/watch?v=WVrlHH14q3o> 11:20