

The **ZONA PELLUCIDA** stays with the embryo until it reaches the uterus. The blastocyst hatches from here.

Match the following terms to the correct definition:

**B – Totipotent**

**C – Pluripotent**

**A – Multipotent**

- a. Have the ability to form a limited range of cells and tissues appropriate to their location (muscle cells for smooth and striated muscle, blood cells for RBC, WBC, and platelets, etc.)
- b. Have the ability to form all cell types of the conceptus (STEM CELLS)
- c. Have the ability to form several types of all three germ layers (ectoderm, mesoderm, endoderm) but not the whole organism

Once the blastocyst enters the uterus between day 7-9 of gestation, the inner cell mass differentiates into three germ layers. Which germ layer does the reproductive system develop from?

- **Mesoderm = REPRODUCTIVE SYSTEM, muscular, skeletal, cardiovascular system, kidney, and urinary ducts**

The ectoderm gives rise to the nervous system, skin, and hair. Which component of the reproductive system develops from this germ layer?

- **Ectoderm = HYPOTHALAMUS, ANTERIOR AND POSTERIOR PITUITARY, CNS, sweat glands, hair, hooves**

What organs are derived from the endoderm?

- **Endoderm = PRIMORDIAL GERM CELLS, digestive/endocrine systems, lungs, liver, pancreas**

Why does the Y chromosome drive primary sex determination?

**SRY gene is on Y chromosome which stimulates male reproductive system to develop**

- **Sertoli cells : secrete AMH (Anti-Mullerian Hormone)**
- **Leydig cells: produce testosterone**
- **No SRY gene = no AMH = female tract develops**

#### The Posterior Pituitary

- a. Only stores oxytocin
- b. Developed from the roof of the mouth
- c. Uses the hypothalamo-hypophyseal portal system
- d. Is the neurohypophysis
- e. Both A and D

#### The Anterior Pituitary

- a. Produces LH and FSH
- b. Develops from the roof of the mouth (gives rise to Rathke's pouch)
- c. Receives chemical messengers via the hypothalamo-hypophyseal portal system
- d. Is the adenohypophysis
- e. All of the above

List and describe the three distinct renal systems:

- Pronephros (Pronephric Kidney) : non-functional primitive form of kidney
- Mesonephros (Mesonephric Kidney) : functional, intermediate kidneys – produce urine that drains into mesonephric ducts:
  - o Mesonephric duct = wolffian duct = forms epididymis, vas deferens in males
  - o Paramesonephric duct = Mullerian duct = forms oviduct, uterus, cervix, and portions of the cranial vagina
- Metanephros (Metanephric Kidney) : final kidney form – gonads increase in size along with this

“Draw” Phenotypical Sexual Differentiation:

	Indifferent Gonads (1 <sup>st</sup> 5 weeks)	
Genetic Sex	XY	XX
Gonadal Sex	Testes (6 <sup>th</sup> -7 <sup>th</sup> week)	Ovaries (9 <sup>th</sup> week)
	Sertoli & Leydig cells	No AMH = No T
Phenotypic Sex	Male genitalia	Female Genitalia

Match the following terms to the correct definition:

**C** Autocrine

**A** Endocrine

**B** Paracrine

- Distant signaling with use of the circulatory system
- Signaling to nearby/adjacent cells
- Self-signaling

The presence of **ESTROGEN** in the brain causes de-feminization of the male hypothalamus.

The hypothalamus surge center has 3 components and is found (**only/both**) in the (male/**female**)

- PON: Preoptic nucleus**
- SCN: Suprachiasmatic nucleus**
- AHA: Anterior Hypothalamic Area**

The hypothalamus tonic center has 3 components and is found (only/**both**) in the (**male/female**)

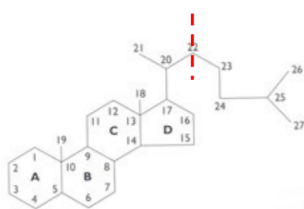
- VMN: Ventromedial nucleus**
- ARC: Arcuate nucleus**
- ME: Median eminence**

Explain what the Hypothalamo- hypophyseal portal system is and its importance:

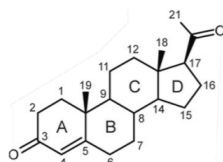
Carries hypothalamic hormones to the anterior pituitary without dilution in systemic blood (capillaries → vein → capillaries)

Important because: allows for rapid response, allows for a large surface area to deliver hormone, little dilution of hormone as they don't have to travel far = only a trace amount needed to cause a response (peptide hormones have a short half-life)

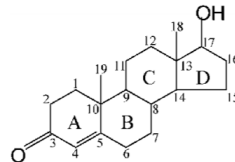
What are these hormones?



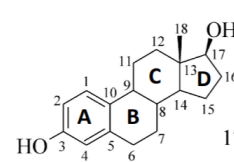
Cholesterol



Progesterone



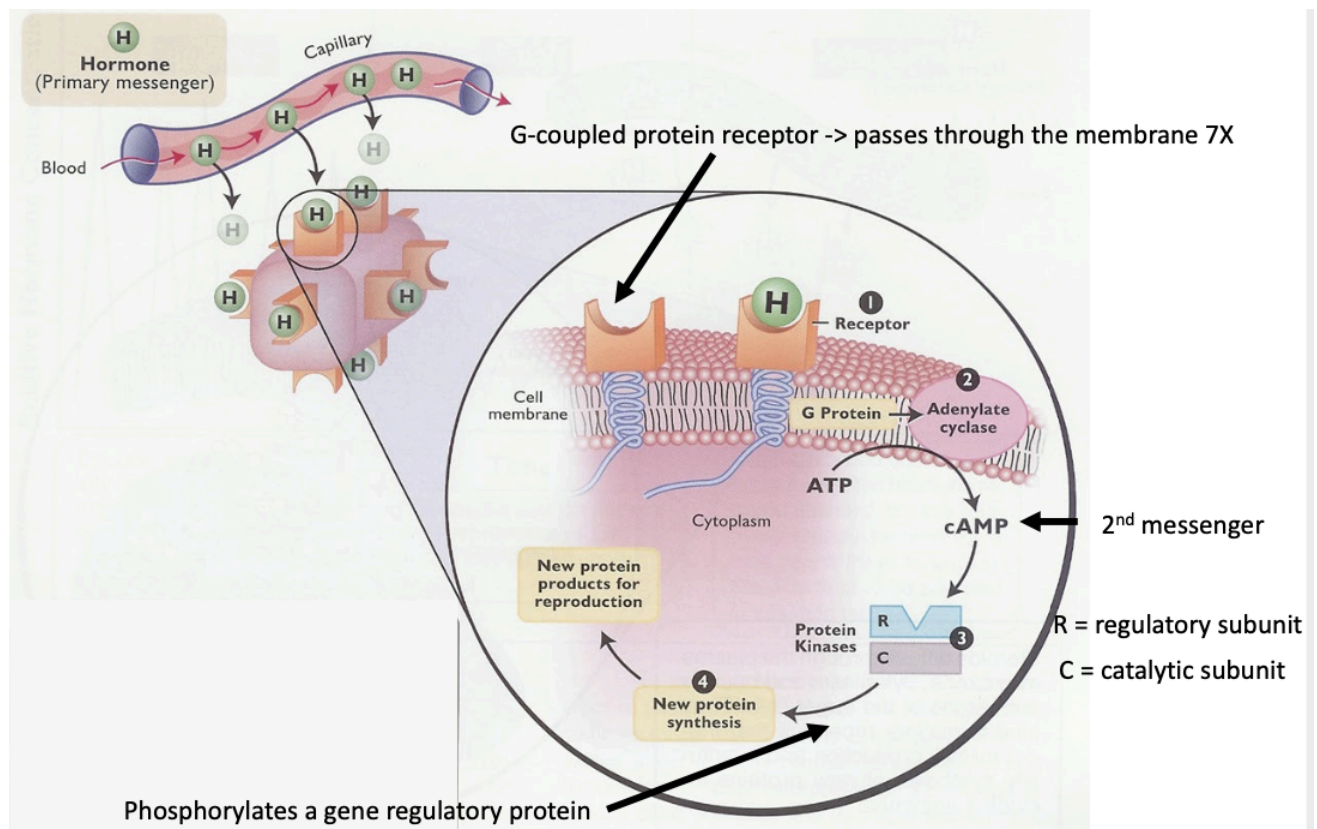
Testosterone

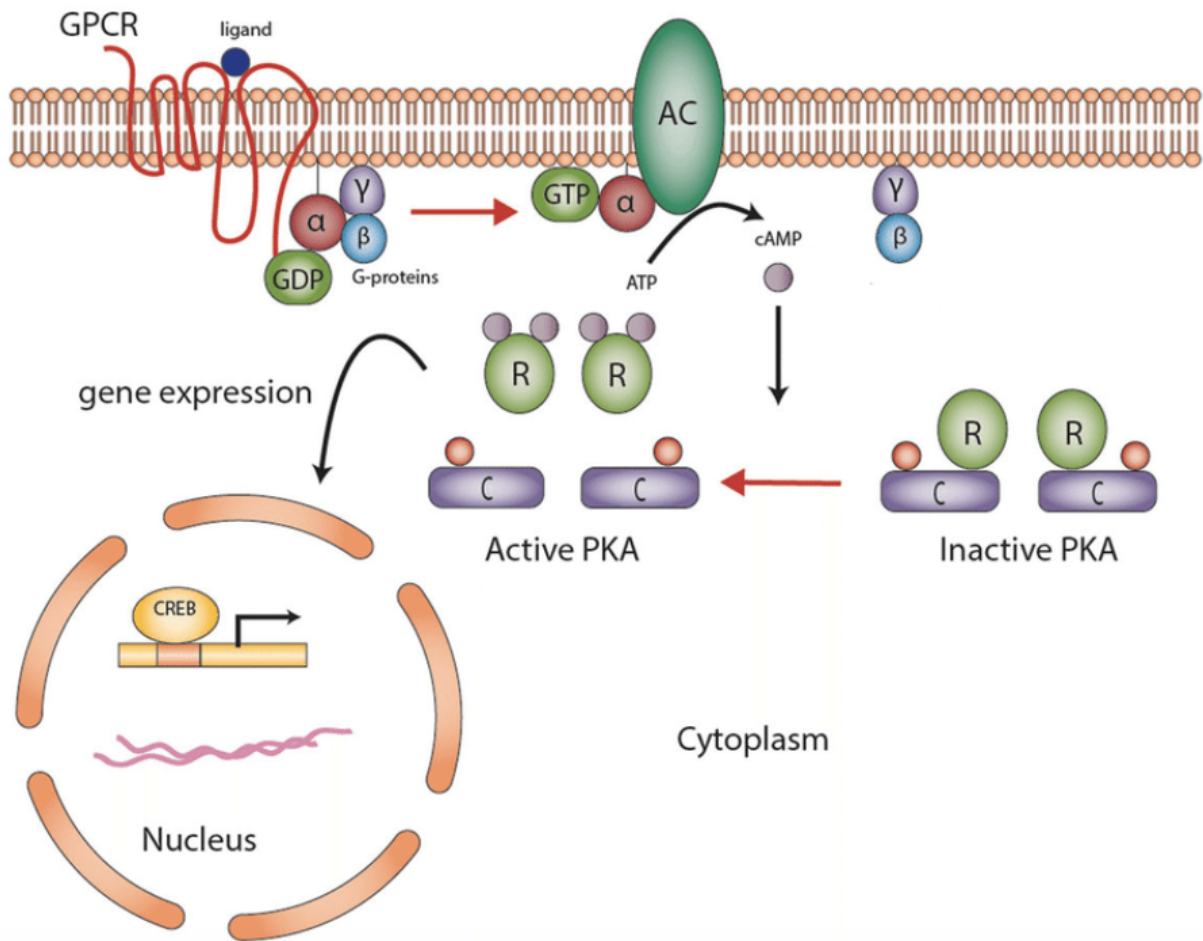


Estrogen

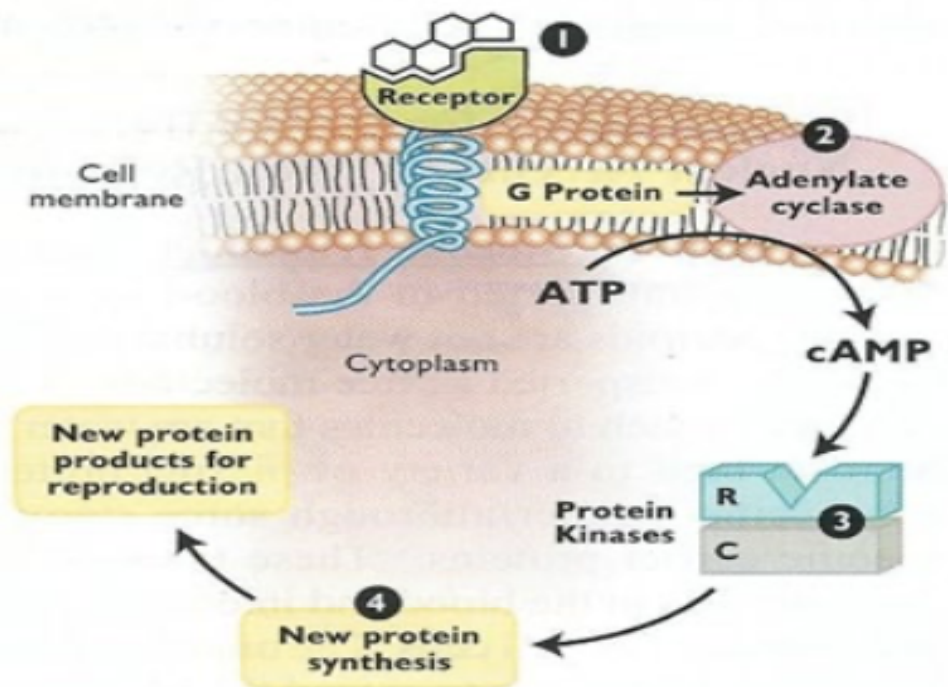
Explain the difference between a slow and fast response?

- Slow response (genomic/classical response) : steroid hormone binds to intracellular receptor → (binds to nuclear receptor) genome interaction, increased mRNA/protein synthesis → in vivo response
  - o Takes hours to days
- Fast response (non-genomic) : steroid hormone binds to membrane/intracellular receptor → Adenylate Cyclase activation → increased secondary messenger and kinase activity → initiates a cellular response
  - o Takes seconds to minutes





## Fast Response



What is puberty?

- a. The ability to accomplish puberty
- b. The ability to accomplish copulation
- c. The ability to accomplish reproduction successfully
- d. The ability to cry

What are some signs of puberty? What does it depend on?

- Signs: ovulation, semen production, mating response
- Dependent on: body size/fatness, environment, social cues, and genetics

What is the key central event of puberty?

- GnRH stimulates gonadotrophins (LH/FSH) which allows for gametogenesis, spermatogenesis and development of reproductive tissues

What are some changes in hypothalamic sensitivity in FEMALES?

Prepubertal female:

Low frequency GnRH pulses from the tonic center results in low stimulation of estradiol resulting in insufficient stimulation of the surge center

Postpubertal female:

Higher frequency GnRH pulses from the tonic center results in stimulation of estradiol above threshold concentrations to stimulate the surge center resulting in the preovulatory LH surge

What are some changes in hypothalamic sensitivity in MALES?

Prepubertal male:

GnRH is very sensitive to negative feedback of testosterone/estrogen

Postpubertal male:

Decreased GnRH sensitive to negative feedback results in more GnRH released producing greater concentration of testosterone/estrogen

What does puberty begin with?

- A "kiss"

Explain Kisspeptin's relationship with GnRH Neurons:

- Kisspeptin neurons are directly affected by blood glucose , fatty acids, and leptin which communicate directly with GnRH neurons

As a follicle increases in size, it produces more and more **Estrogen** (steroid hormone) which travels in the blood (bound to carrier protein) to the hypothalamus. The **tonic** (tonic or surge) center first becomes less sensitive to the negative feedback of estrogen. This shift stimulates a **higher** (higher or lower) frequency of GnRH pulse from the **tonic** (tonic or surge) center which leads to further growth and development of follicles. Continued follicular growth stimulates concentrations of estrogen **above** (above or below) the threshold which in turn stimulates the **surge** (tonic or surge) center of the hypothalamus. Stimulation of the **surge** (tonic or surge) center of the hypothalamus results in the surge of **LH** (LH or FSH) thus causing ovulation.

What is the ultimate goal of reproductive behavior?

**Pregnancy, successful embryogenesis, and parturition**

What elemental compound is essential for erection to occur?

**Nitric Oxide : causes vasodilation**

Match the following definitions to their correct term:

**A** – Attractivity **B** – Proceptivity **C** – Receptivity

- Behavior and other signals that attract males (posture, pheromones, phonation)
- Stimulate males to copulate or re-initiate sexual behavior (female-female mounting)
- Copulatory behavior (standing response, tail deviation, backing up towards male)

What happens when sperm is deposited in the FRT?

- Retrograde loss (backflow)
- Phagocytosis (leucocytes kill foreign material)
- Remaining sperm (they cannot swim yet) have to travel through the cervix with the help of sialomucin, to the uterus, to the oviduct where it binds the oocyte, undergoes acrosome reaction, penetrates the zona pellucida, and fuses with the oocyte plasma membrane

True / False : Capacitation is not reversible. **False – capacitation is reversible**

Where does capacitation begin in the FRT? Where is capacitation completed?

- Within the uterus ; oviduct

What must be present on the sperm to penetrate the COC?

- Decapacitation factors
- The acrosome
- Zona pellucida
- Estrogen

The zona pellucida is made up of 3 glycoproteins. What are they?

- ZP1/ZP2: structural proteins
- ZP3: receptor that binds to proteins on sperm membrane

Sperm plasma membrane have 2 ZP binding sites. What are they?

- ZBR: Zona Binding Region- adheres sperm to zona pellucida (ZP3)
- ARPR: Acrosome Reaction Promoting Region- binds to ZP3 and initiates the acrosome reaction

Where does the acrosome reaction occur?

- In the oviduct

What is syngamy?

- Fusion of male/female pronuclei to create a diploid zygote