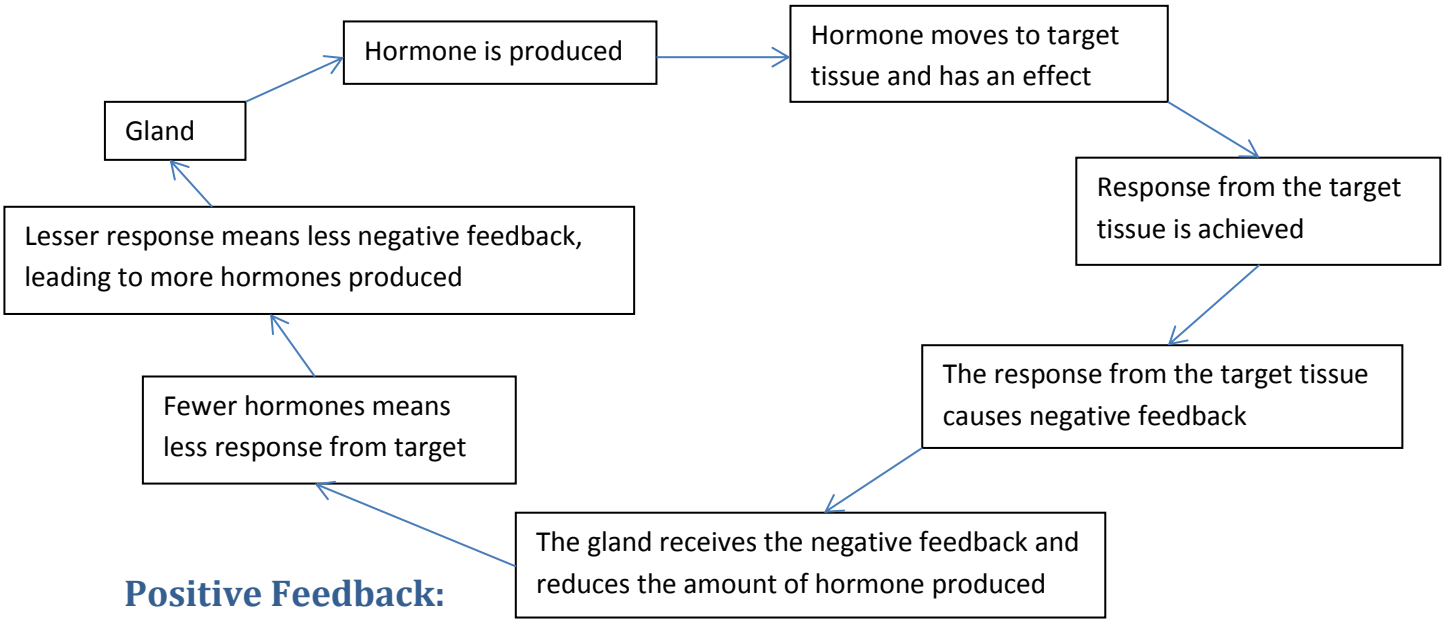
Hormone Control of Reproduction:

- Hormones are chemical messengers which travel through the blood
- Hormones are involved in every aspect of human reproduction; from sexual differentiation, production of gametes, the birthing process and even lactation of females
- Hormones are produced by endocrine glands; which secrete their products into extracellular fluid and blood vessels
- Hormones only affect a specific cell type
    - The target organ or target cells have receptors which are specific to the hormone
    - Receptor may be found on a cell's membrane on intracellular (usually on the nucleus)
- There are three main types of hormones: stories, peptides and eicosanoids (prostaglandins)
    - Steroids are derived from cholesterol so they are able to easily pass through the cell membrane; the four main types of steroids are androgens, oestrogen, progesterone and corticoids. Steroids interact with the target cell by moving through the cell membrane and interacting with the receptors on/in the nucleus
    - Eicosanoids are derived from acids secreted from the cell membrane of certain cells that produce them. Prostaglandins are part of the eicosanoid hormones; eicosanoids are produced in the myometrium in females and seminal vesicles in males
    - Peptide hormones include gonadotropin releasing hormone (GnRH), luteinising hormone (LH), follicle stimulating hormone (FSH), oxytocin and prolactin in the reproductive control
- Both peptide hormones and eicosanoids interact with receptors on the cell surface which sends a secondary messenger into the cells

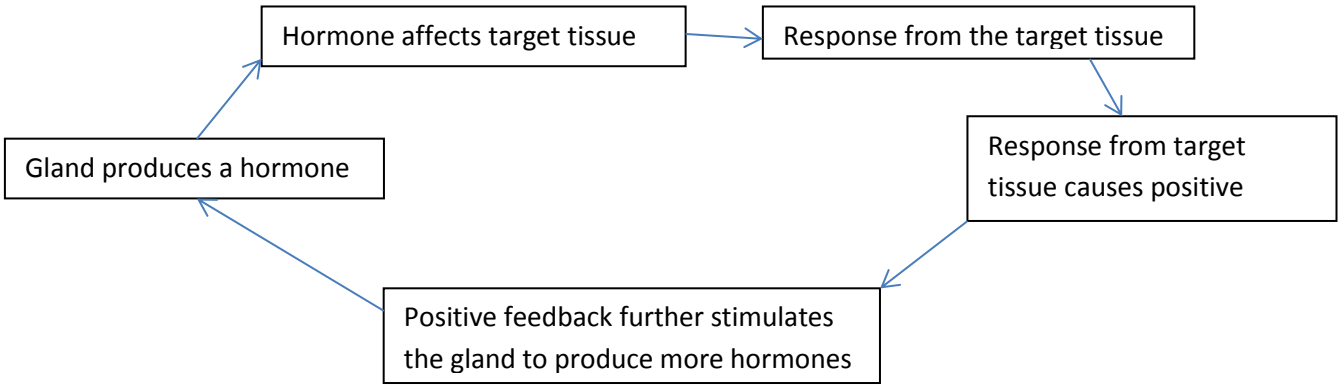
Types of Hormone Action:

- There are four types of hormone action: endocrine, paracrine, autocrine and exocrine
- Endocrine indicate that the gland which secretes the hormone is a relatively long distance away from the target cells
    - For example the luteinising hormone from the anterior pituitary acting on Leydig cells in the testis
- Paracrine indicates that the secretory cells are next to or close to the target cells
    - For example the Leydig cells secrete testosterone which travels across the seminiferous tubules to the Sertoli cells
- Autocrine cells produce a hormone which affects itself
    - For example the ovarian follicles produce oestrodiol to which it also responds
- Exocrine glands secrete their hormones into a duct of some form
    - For example when an ovarian follicle is ruptured it releases some oestrodiol into the uterine tube

Negative Feedback:



Positive Feedback:



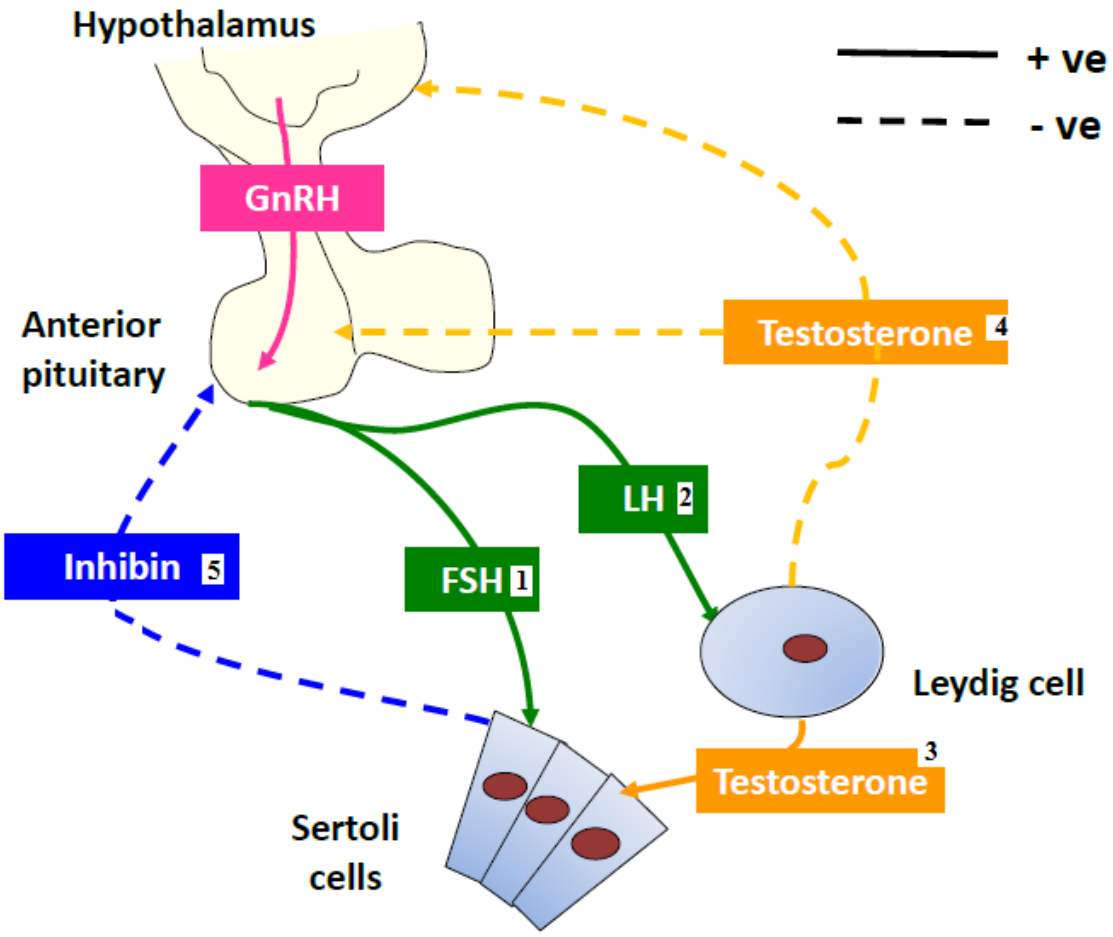
- There are two main instances of positive feedback in reproductive biology: ovulation and childbirth
- The positive feedback loop is only broken when the system breaks down

Hierarchy of Hormone Control:

- The hypothalamus receives input from all areas of the body and it is responsible for maintaining homeostasis
    - The hypothalamus mediates the input and controls reproduction corresponding to the input by releasing Gonadotropin releasing hormone (GnRH)
    - GnRH affects the secretion of gonadotropins from the anterior pituitary gland
- The anterior pituitary gland receives GnRH from the hypothalamus and releases the gonadotropins: luteinising hormone LH and follicle stimulating hormone FSH
    - Gonadotropins affect the gonads and cause the production of oestradiol, progesterone, testosterone and inhibin depending on the sex of the individual
- The hormones from the gonads are typically feedback to the hypothalamus to cause a decrease in GnRH secretion
    - Less GnRH results in less gonadotropins being released

- Less gonadotropin results in less of the sex hormones which reduces the feedback to the hypothalamus causing less GnRH secretion (negative feedback)

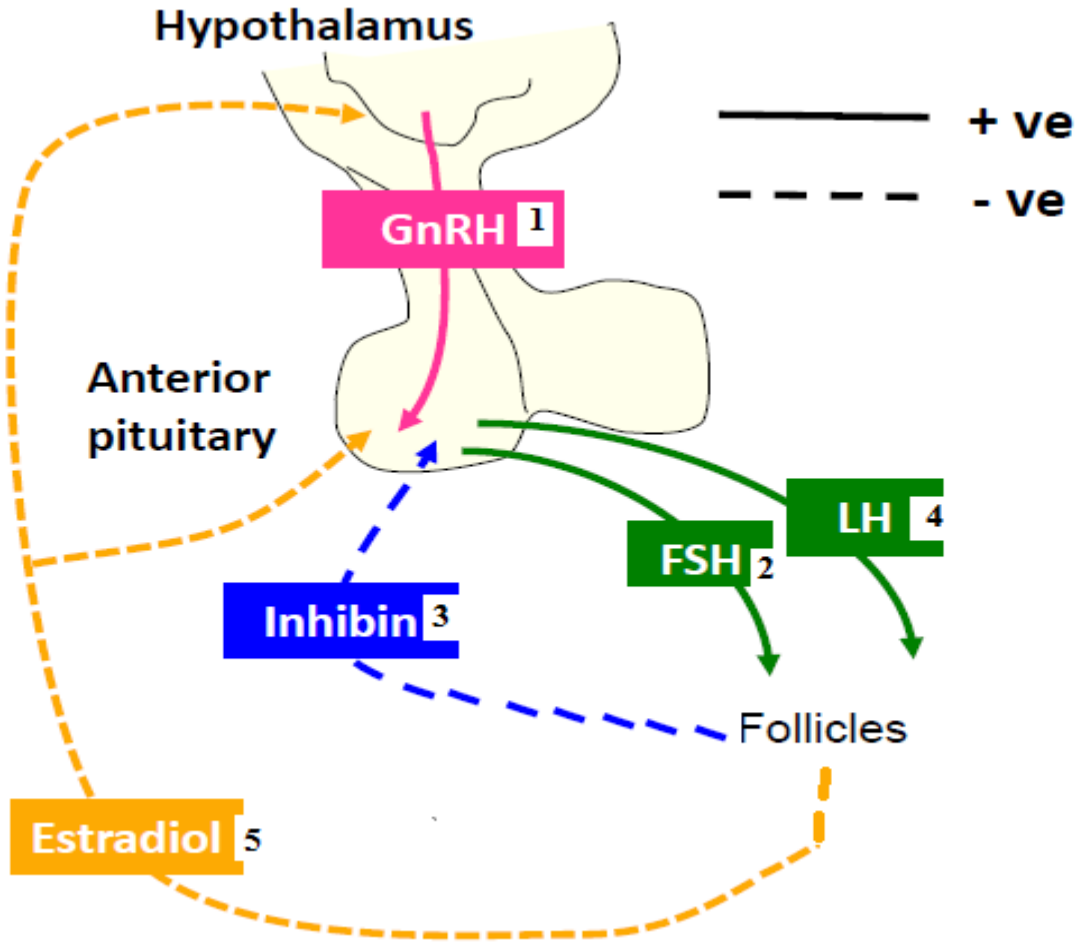
Endocrine Control of Spermatogenesis:



- GnRH is produced in a pulsatile fashion; episodic secretion depending on the input of information
    - Episodic secretion is vital, continuous secretion would not work
- 1) in response to FSH, Sertoli cells produce receptors to androgens
- 2) in response to LH, the Leydig cells produce testosterone
- 3)Acting in a paracrine fashion, testosterone from the Leydig cells bind to the receptors on the Sertoli cells allowing the Sertoli cells to control Spermatogenesis
- 4) Testosterone from the Leydig cells also travels to other parts of the body (acting as an endocrine gland). The testosterone from the Leydig cells provide negative feedback to the hypothalamus and anterior pituitary gland
    - This causes the hypothalamus to decrease GnRH production
- 5) Inhibin is produced by the Sertoli cells, which provides negative feedback to the anterior pituitary gland which decreases FSH secretion
    - Decreasing FSH secretion causes the number of receptors on the Sertoli cells to decrease
    - This allows the rate of spermatogenesis to be controlled

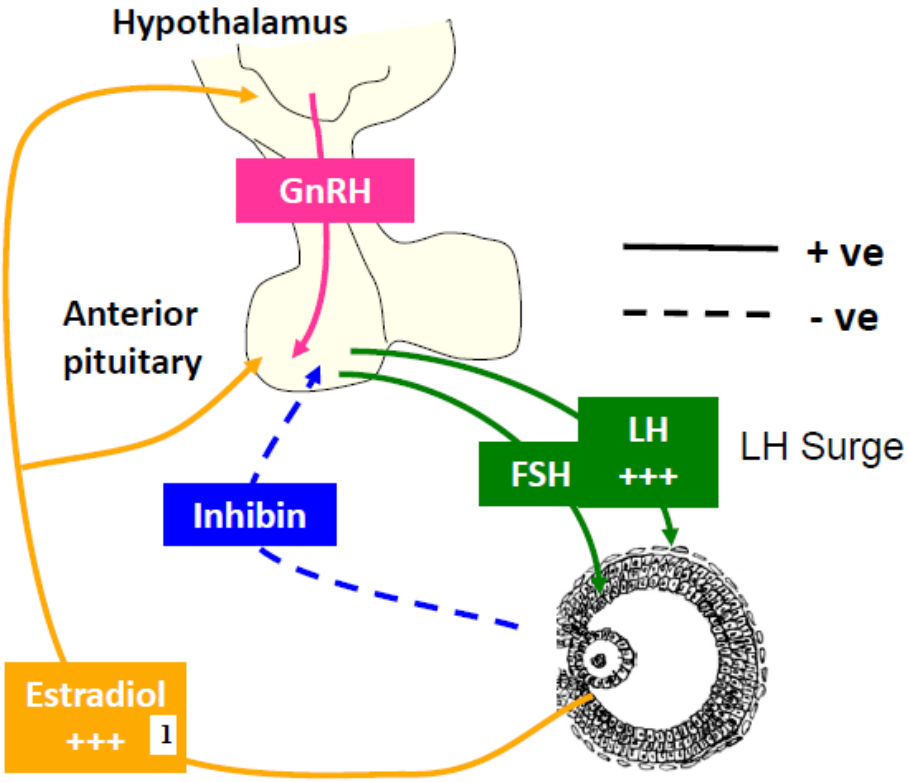
Endocrine Control of the Ovarian Cycle:

- During the late luteal phase of the previous cycle and the beginning of a new cycle (first day of menstruation)

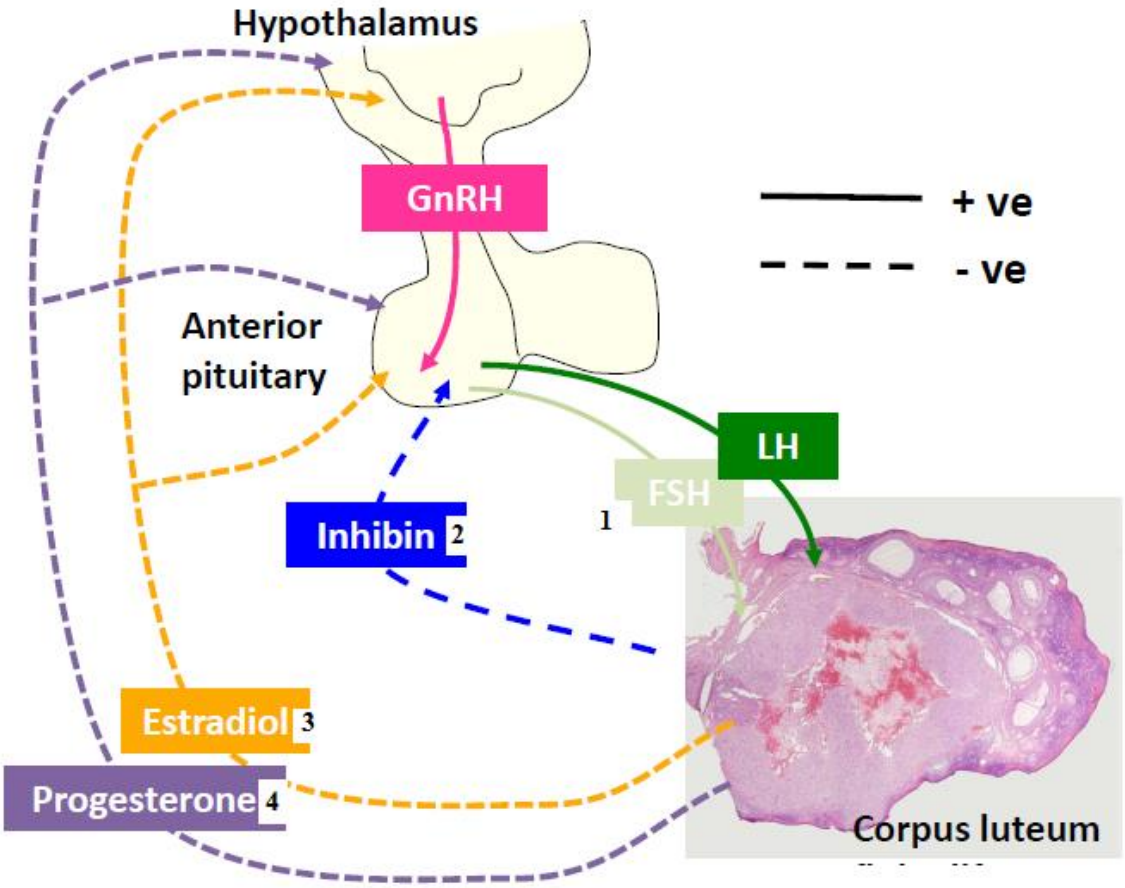


- 1)GnRH is episodically released by the hypothalamus
- 2) FSH is secreted and the antral/secondary follicles begin to mature (toward pre-ovulatory/Graafian follicles); roughly 20 follicles will begin development but typically one will reach full maturity
- 3) the maturing follicles secrete inhibin which causes negative feedback to the anterior pituitary gland; this decreases the amount of FSH secreted
    - So as the follicles mature further, less and less FSH is produced. This results in only one follicle reaching full maturity
- 4) LH makes the mature follicle secrete oestradiol which causes negative feedback with the hypothalamus and anterior pituitary
- 5) The negative feedback from oestradiol secretion causes less GnRH to be secreted and the anterior pituitary's response to GnRH to decreases which results in FSH and LH secretion to reduce as well

- During the late follicular phase, just prior to ovulation
- 1) The feedback of oestradiol changes from negative to positive at a certain threshold which is unique in individuals
    - The Graafian follicle produces mass amounts of oestradiol, and in response to the large amounts of oestradiol the anterior pituitary becomes more sensitive to GnRH and the hypothalamus releases more GnRH
    - The increase in GnRH secretion causes a large surge in LH which results in ovulation, as well as causing ovulation, the surge of LH causes the formation of the corpus luteum from the ruptured follicle



- The luteal phase (without pregnancy)



- 1) FSH levels are kept fairly low because of inhibin being constantly secreted by the corpus luteum
- 2) Inhibin is secreted by the corpus luteum which affects the anterior pituitary to supress FSH secretion; this prevents another follicle from developing as long the corpus luteum is present
- 3) The corpus luteum secretes large amounts of oestradiol, but positive feedback is not achieved because of the presence of a new hormone: progesterone
- 4) Progesterone provides negative feedback to the hypothalamus to decrease GnRH secretion which cause LH levels to decrease
- Should pregnancy occur, the corpus luteum is maintained for roughly three months
    - It will continue to produce oestradiol and progesterone to supress FSH, LH and GnRH
    - The corpus luteum is maintained by the hormone human chorionic gonadotropin hCG which is secreted by the embryo