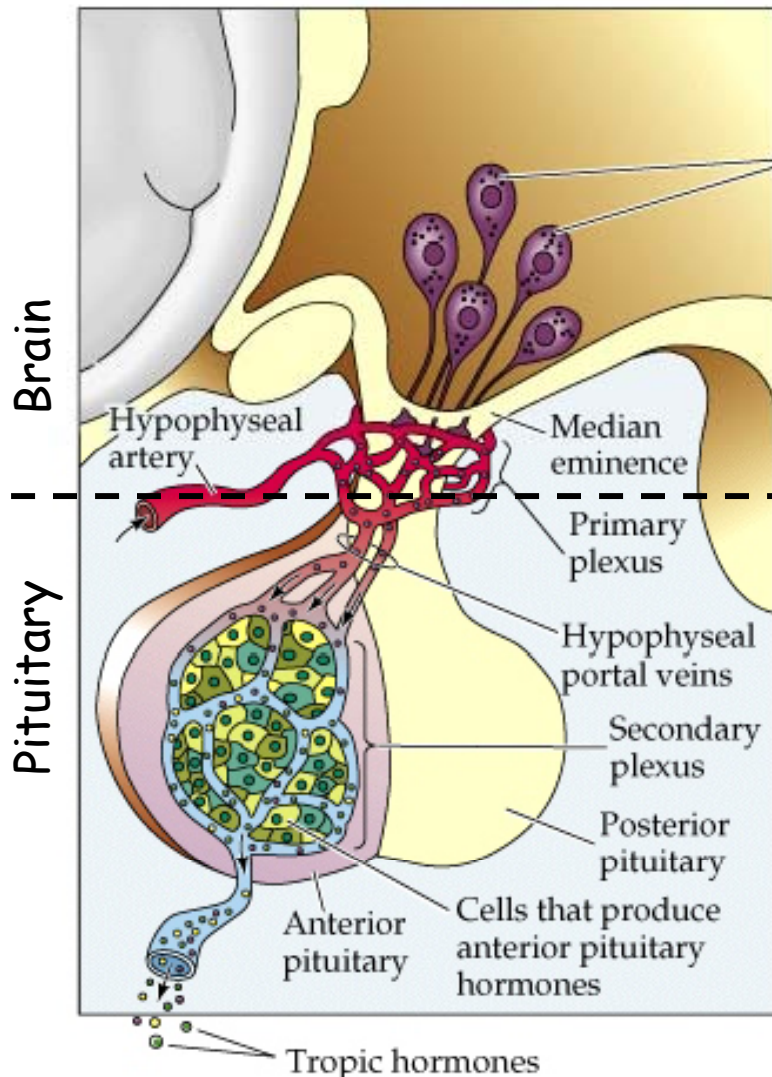


Sex: Hormonal and Neural Basis (Ch 12)

- Sex hormones
 - Regulation by anterior pituitary
 - Gonadal Sex Hormones
- Sexual Development and Differentiation
 - Development of the **Body**
 - Hormonal regulation of in utero development

Reminder: course website: www.psych.ubc.ca/~floresco

Hypothalamic regulation of sex hormones



Neuroendocrine cell bodies in the hypothalamus produce releasing and inhibiting hormones ...

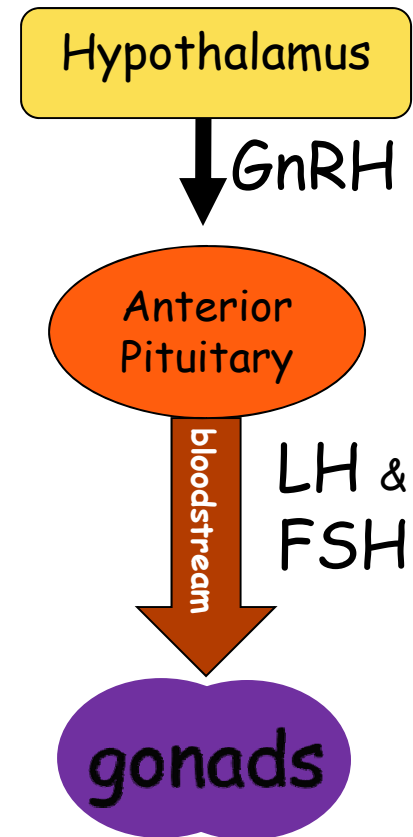
- The hypothalamus regulates the release of sex (gonadal) hormones via the anterior pituitary
- The process starts by neuroendocrine cells in the hypothalamus releasing a hormone called gonadotropin-releasing hormone (GnRH)
- In turn, the anterior pituitary releases hormones into the bloodstream that target the gonads.

LH & FSH

Gonadotropic hormones

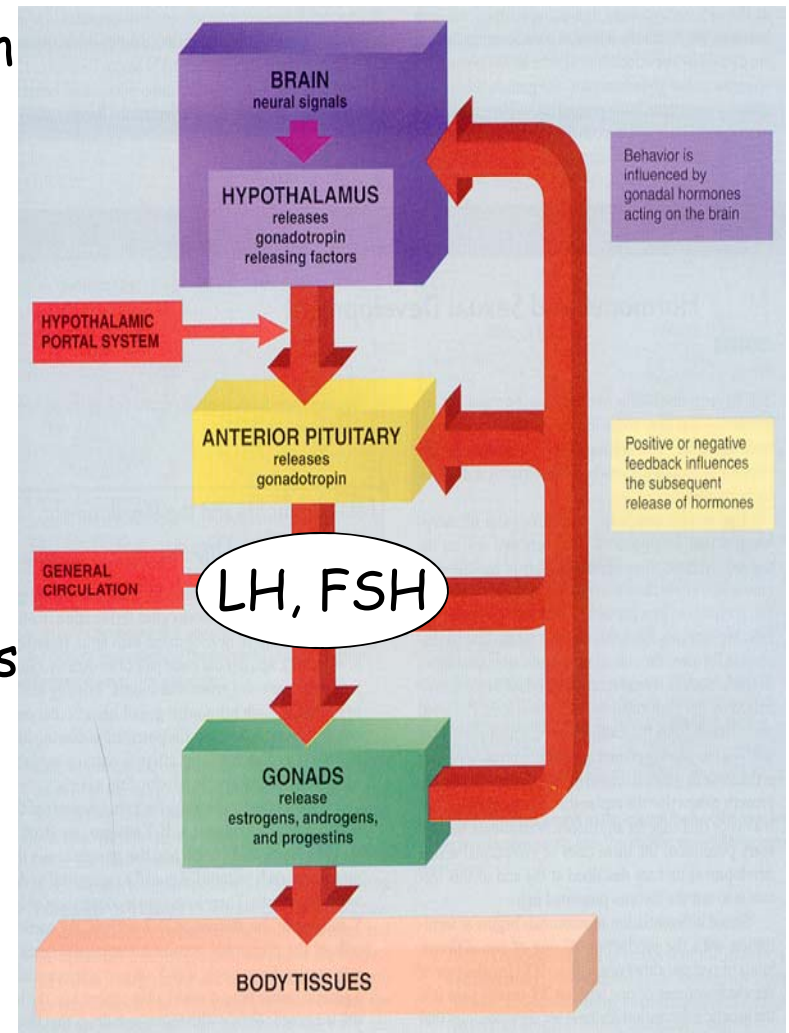
Gonadotrophic Hormones of the Anterior Pituitary

- Stimulate the gonads (testes and ovaries)
- Two primary types, released in both males and females
- 1) Luteinizing hormone (LH)
 - Females = ↑ progestins
stimulates release of eggs from the ovaries, prepares uterine lining for implantation
 - Males = ↑ testosterone
- 2) Follicle-stimulating hormone (FSH)
 - Females = ↑ estrogens; Males, ↑ testosterone
 - Influences egg and sperm production



Gonadal (Sex) Hormones

- Steroid hormones, two classes
- **Androgens:** testosterone (T) most common
 - Dihydrotestosterone: another androgen, much more potent form of T
- **Estrogens:** Estradiol most common
 - **Where do they come from?*
- **Ovaries:** release much more estrogens than androgens
- **Testes** release much more androgens than estrogens
- Adrenal Cortex also releases small amounts of these sex hormones as well
 - Adrenal corticosteroids secretion inhibits release of androgens



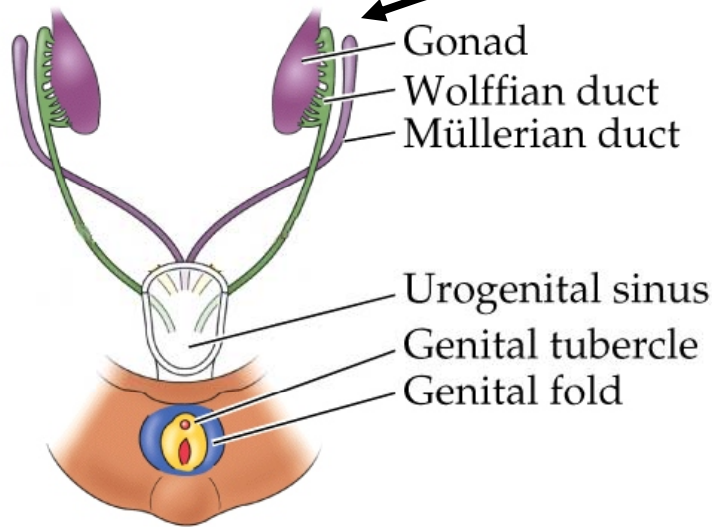
Where do we come from?

- Sexual Development (*in utero*)
- You learned in high school biology that the two sexes are determined genetically
- XX = female XY = male
- So if you have a Y chromosome, you are going to be a male, and if you don't you are going to be a female, right?

NOT THAT SIMPLE!

Sexual Development (Gonadal)

(a) 6 weeks (undifferentiated)



At 6 weeks of age the primordial gonads of XX and XY individuals are identical



Female (XX)

Male (XY)



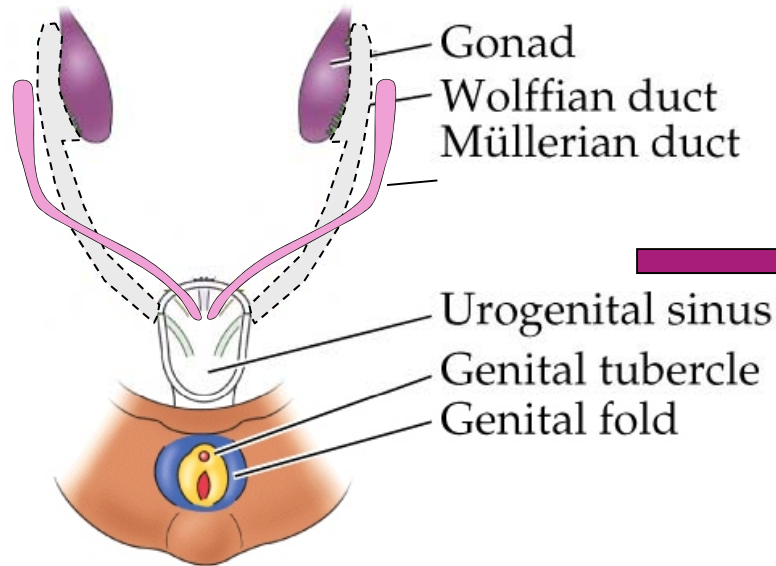
- Y chromosome has **SRY** gene
- Encodes for **SRY** protein
- Shows up @ week 7 of development
- SRY protein causes **TESTES** formation
- NO SRY** = **OVARY** formation

No SRY =
OVARY
(from cortex)

Yes SRY =
Testes
(from medulla)

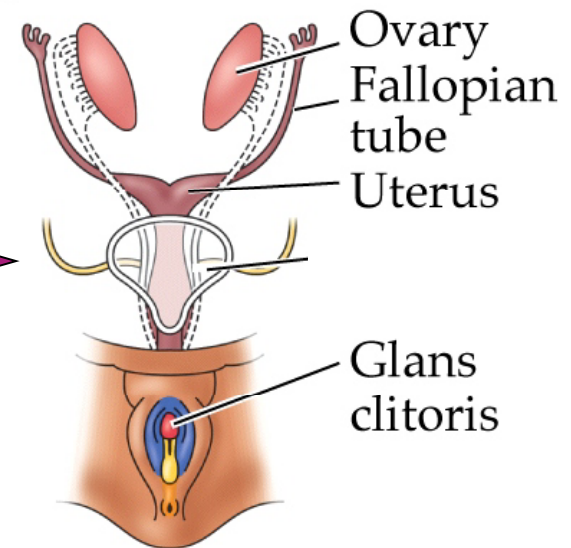
Female (XX) Sexual Development

(a) 6 weeks (undifferentiated)



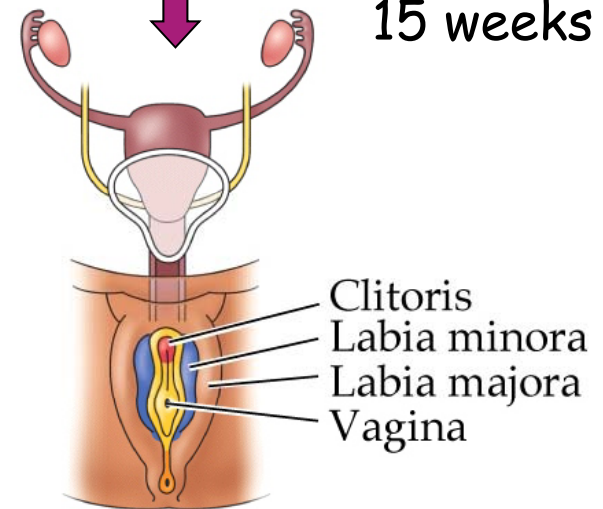
Female

8 weeks



(e)

15 weeks



NO Y chromosome means:
NO TESTOSTERONE

NO testosterone means:
-Wolffian ducts shrink away
-Mullerian ducts grow

Forms fallopian tubes, uterus, part of vagina
Starts around week 7

-Forms as phenotypic female

Male (XY) Sexual Development (1)

Y chromosome means:

SRY GENE = SRY PROTEIN

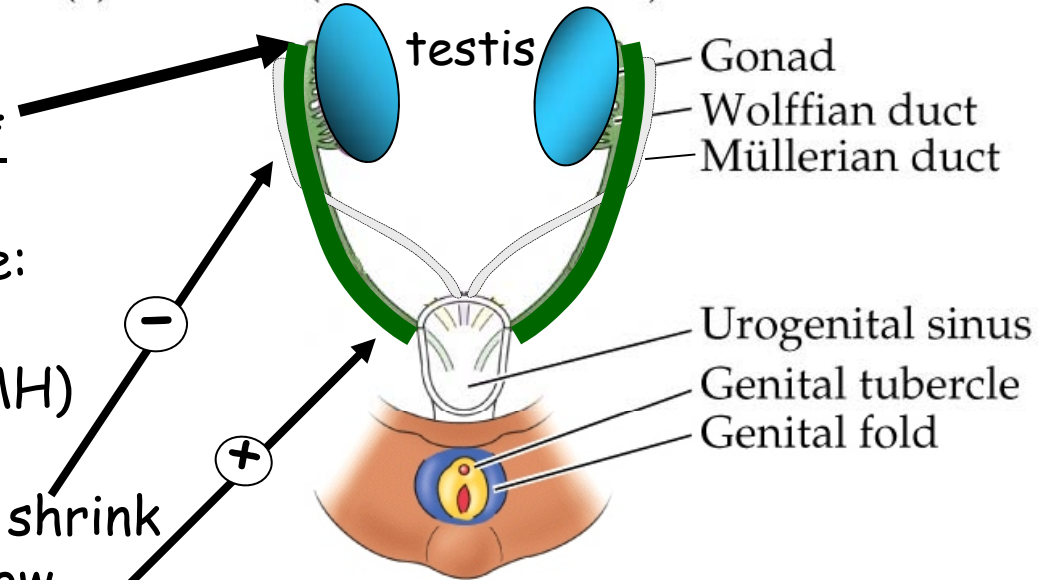
- Testes form and start to make:

- 1) testosterone
- 2) Anti-Müllerian hormone (AMH)

- AMH causes Müllerian duct to shrink

- T causes Wolffian ducts to grow

(a) 6 weeks (undifferentiated)



Occurs around week 7

Male Sexual Development (2)

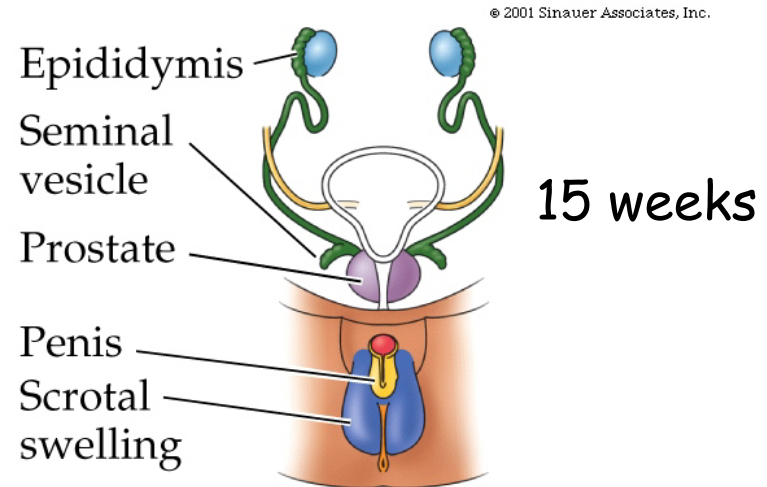
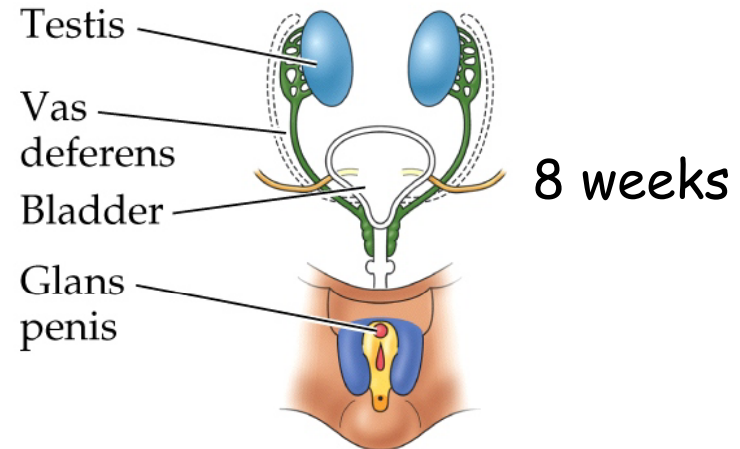
- T masculinizes other structures through development

- prostate gland
- scrotum
- penis

- These effects are aided by dihydrotestosterone (DHT)
- Cells in these areas have enzyme 5 α -reductase = converts testosterone into DHT

- Forms phenotypic male

(b) Male



Critical points

- Development into phenotypic male or female controlled by **PRESENCE** or **ABSENCE** of **TESTOSTERONE**
- **NOT** controlled by estrogens
- Genes play a role, but presences/absence of hormones (testosterone) plays an equal or greater role in what you look like when you're born, depending on what's in the blood stream during this Critical Period
- **Sex chromosome controls sex of the gonad**
- **GONADAL hormones determines sex of rest of the body**

When Good Development Goes Bad (1)

- **Androgen Insensitivity Syndrome**
 - Genetic defect: no functional androgen receptors
 - No effect of T during development:
 - Testis form (SRY from Y chromosome), remain internal
 - Mullerian duct atrophy (AMH from testes) but Wolffian ducts DO NOT develop (no effect of T)
 - Female external genitals develop (no effect of T)
 - During puberty, secondary sex characteristics develop from estrogens released from adrenal glands and testes
 - Look and behave like XX genetic women on the outside, but no menstruation, no body hair.

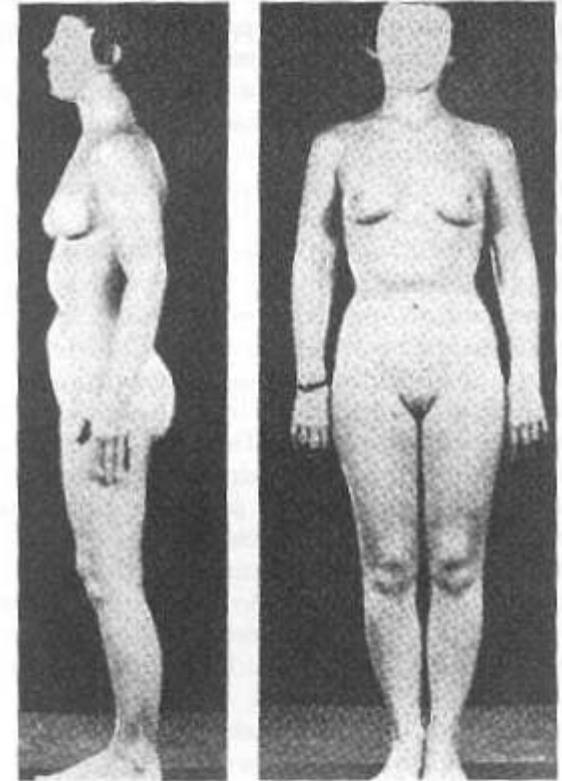


Figure 11.10 A woman with an XY chromosome pattern but insensitivity to androgens. Two undescended testes produce testosterone and other androgens, to which the body is insensitive. The testes and adrenal glands also produce estrogens that are responsible for the pubertal changes. (Source: Federman, 1967)

When Good Development Goes Bad (2)

- **Androgenital Syndrome**
- Caused by congenital adrenal hyperplasia (CAH)
 - Normally, fetal adrenal glands produce cortisol, inhibits T release from adrenals
 - Some fetus have defect; not enough cortisol produced = MORE THAN NORMAL T
- T goes on to masculinize parts of XX fetus
 - Primordial gonads still form ovaries
 - Both Wolffian AND Mullerian ducts grow
 - External genitalia are "intersex"; look like a cross between male and female at birth (can be corrected by surgery)
- Gender identity varies; some are raised as girls, but look like boys in puberty and vice versa

