

## The Basics of Reproductive Anatomy & Physiology

1. Basic male & female anatomy
2. Production of reproductive hormones
3. Production of sperm or eggs
4. Common reproductive disorders

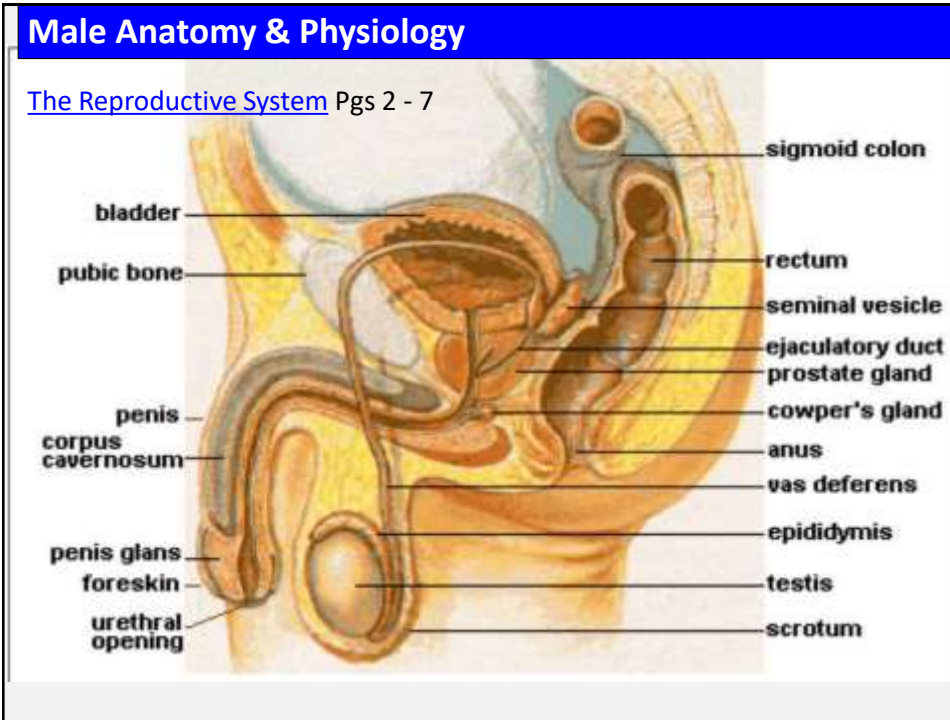
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## The Basics of Reproductive Anatomy & Physiology

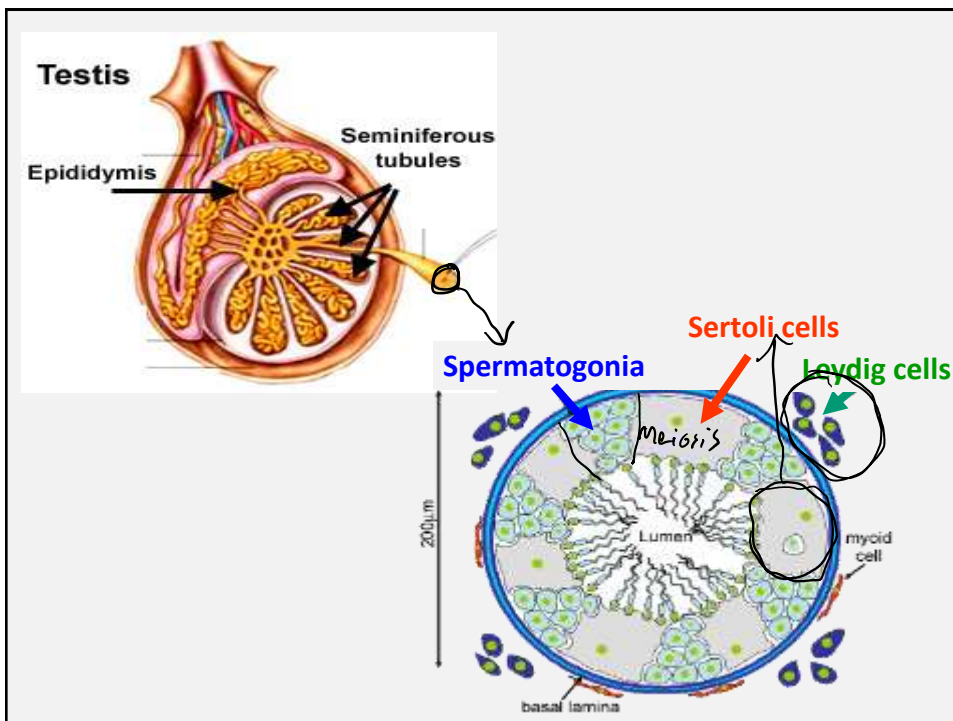
### Reading Assignments:

1. [The Reproductive System](#)
2. [Male Andropause, parts 1](#)
3. [Male Andropause, part 2](#)
4. [Cervical Cancer Vaccine](#)
5. [Genital Mutilation](#)
6. [Hormone Replacement Therapy](#) (WHI study)

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## Male Anatomy & Physiology

testes = paired gonads that produce sperm and testosterone



Seminiferous tubules = coiled tubes within testes where sperm produced.

### 3 cell types in seminiferous tubules:

1. Sertoli cells - respond to <sup>Pituitary</sup> FSH by helping in sperm production.

2. Leydig cells - respond to <sup>Pituitary</sup> LH by producing testosterone

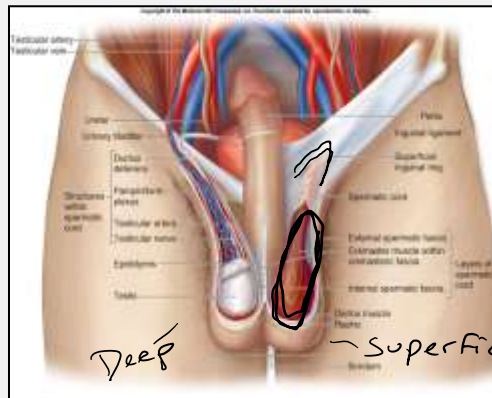
3. Spermatogonia = go through meiosis to become sperm.

Epididymis = where <sup>(sperm warehouse)</sup> sperm stored & mature before ejaculation.

Scrotum = contain testes outside of abdomen ~3° lower than body temp of 98.6.

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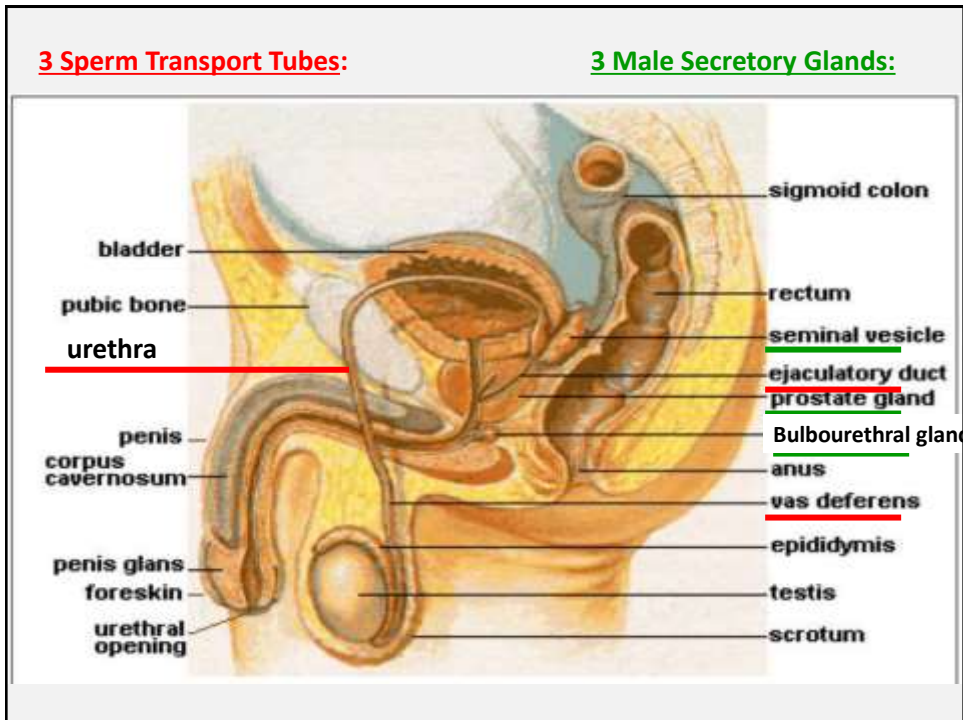
Cremaster = muscle that lifts/lowers testes for temperature regulation.



Inguinal Ring = opening in abdominal cavity where testes descend into scrotal sac of male fetus by 7 months gestation.

Cryptorchidism = when one or both testes are retained within the abdomen. Abnormal! Must be removed or risk testicular cancer.

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**3 Sperm Transport Tubes:**                      *→ longest*

- Vas deferens = transport sperm from epididymis to seminal vesicles.

QUESTION: What is a **vasectomy**? *surgical cutting of the 2 vas deferens (permanent birth controls)*

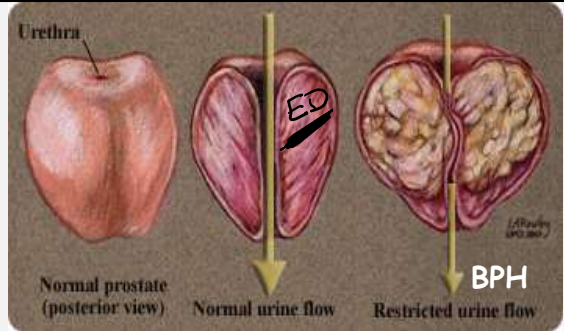
- Ejaculatory duct = found in prostate gland.
- Urethra = passageway for urine or semen, but not at same time!

**3 Male Secretory Glands:**

- Seminal vesicles = Largest glands contributing to semen.  
produce:
  - -alkaline mucus (counteract vaginal acidity)
  - -prostaglandin (cause uterine contractions)
  - -fructose (energy source)
- Prostate - produce alkaline mucus.
- Bulbourethral gland - produces lubricant during sexual arousal. *pre-cum*

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## The Prostate Gland



- not cancerous

### > Benign Prostate Hyperplasia (BPH)

- Prostate grows with age.
- non-cancerous growth of prostate.
- Can block urine or semen transport.

Hyperplasia <sup>growth</sup>  
= excess

ALSO BRCA gene test  
(more expensive)

### Prostate cancer

- Malignant ~ cancerous
- Detect with PSA = prostate-specific antigen. High levels in blood indicate possible prostate cancer.

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## The Penis

Cavern - tunnel.

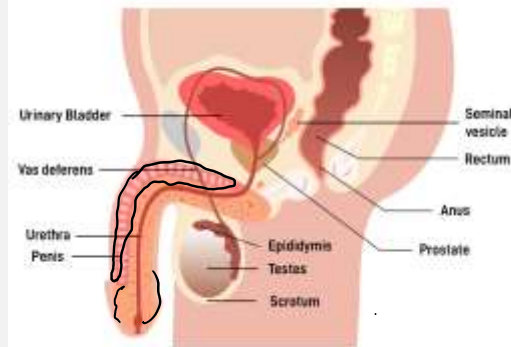
\* Corpus cavernosa = upper left and right chamber

- have arterial blood supply to fill with blood.
- arteries open up (vasodilate) based on nitric oxide (NO) & cGMP.

Corpus spongiosum = lower chamber surrounding urethra

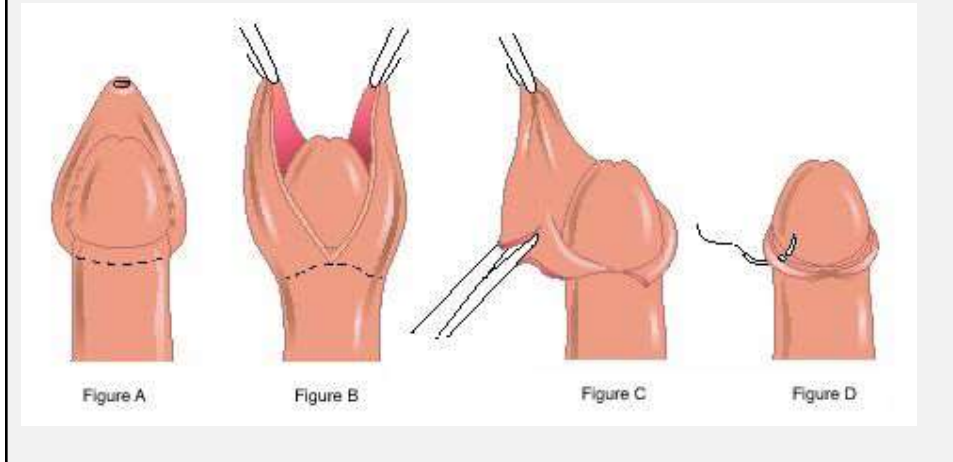
Foreskin (prepuce) = loose flap of skin covering the head (glans) penis.

Circumcision  
= surgical removal of the foreskin.



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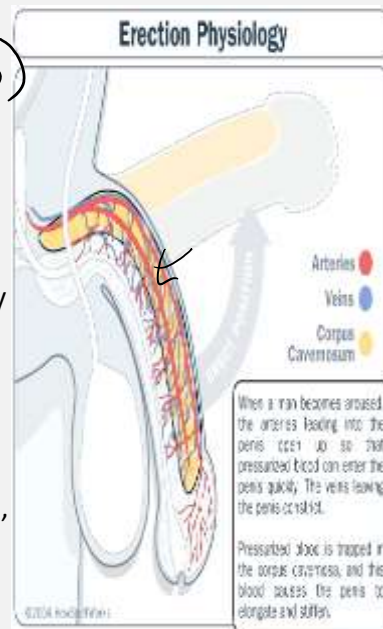
Circumcision?  
To do, or not?  
Click [HERE](#) for further reading.



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### How an erection works:

1. **Stimulation** Causes Nitric oxide (NO) release in arteries of corpus cavernosa.
2. NO causes production of a chemical messenger called cGMP.
3. cGMP causes arteries to relax & they open wide (vasodilate) allowing blood into spongy chambers.
4. Fluid pressure of blood causes erection.
5. When stimulation done, or after ejaculation, cGMP is broken down by enzyme (Phosphodiesterase). Erection ends.



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**Erectile Dysfunction (ED)** = inability to achieve or maintain an erection.

Many possible causes:

Treatments:

1. Counseling if psychological \*\*\*

2. Pharmacological (drugs)

A) Testosterone supplements

B) ED drugs (ex. Viagra, Cialis, Levitra) ← blood flow problem

3. Surgical options:

A) Semi-rigid malleable rod implanted into penis.   
 Can manually straighten rod for erection.   
 — bend it up or down

B) Inflatable implant = implant fluid reservoir into abdomen, pump into scrotum, and tubes into penis. Squeeze the pump to push fluid into tubes for erection. Hit a release valve to return fluid to reservoir to end erection.

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**How ED Drugs work (Viagra, Cialis, Levitra):** - side effects  
 • ↓ blood pressure (fainting, blurred vision)  
 • Priapism - erection lasting longer than 3-5 hrs

Phosphodiesterase - inhibitor = a chemical that inhibits phosphodiesterase. - so enzyme does not break down cGMP.

So ..., what would giving one of these drugs do to cGMP levels in the corpus cavernosa?

↑ cGMP

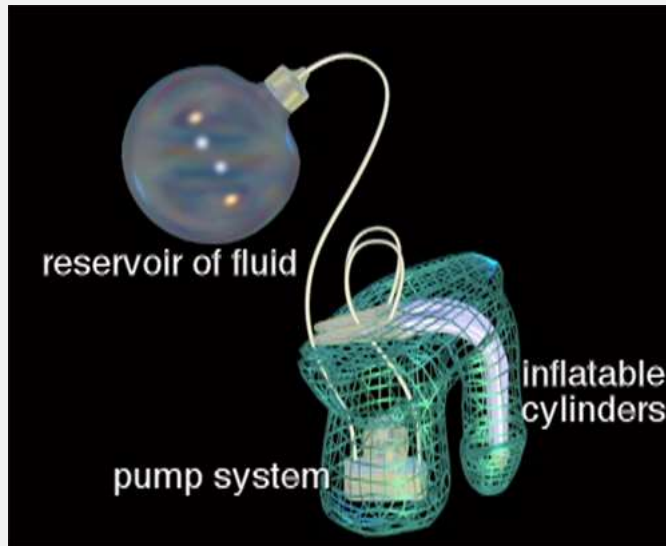
What would that do to arteries in the penis? stay vasodilated

What would that do w/respect to an erection? helps it

**Viagra, Cialis, & Levitra work this way.**

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### ED surgical options: Inflatable penile implant or Semi-rigid malleable rod



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### Steroidogenesis in males & females:

*sex hormones (testosterone & estrogen)*

Steroidogenesis = production of sex steroids in males & females.  
*make*

#### The BRAIN controls steroidogenesis!

- Hypothalamus = brain structure that controls it.
- Hypothalamus secretes GnRH = gonadotropin-releasing hormone.  
*gonad*
- GnRH tells anterior pituitary (in brain) to secrete LH & FSH  
(see next slide!)
- LH tells testes to make testosterone & ovaries to make estrogen.  
*ovulate an egg.*
- FSH tells testes to mature sperm & ovaries to mature eggs.

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## Steroidogenesis in males & females:

Pituitary

LH (luteinizing hormone)

> stimulates testes (leydig cells) to make testosterone

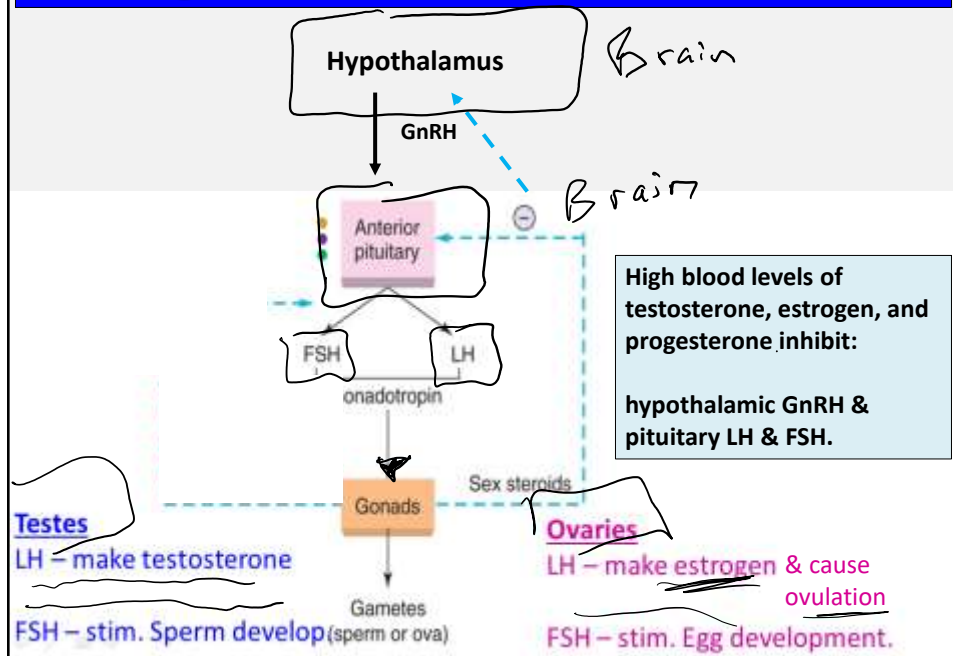
> Stimulates ovaries to make estrogen  
 & to ovulate an egg

When levels of testosterone, estrogen, or progesterone are high it inhibits pituitary release of LH & FSH as part of negative feedback to control hormone levels.

FSH (follicle-stimulating hormone) - stimulates sperm or egg maturation

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## Steroid regulation in males & females:



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## Making sperm

Gametogenesis = production of eggs or sperm.

> Spermatogenesis = production of sperm in seminiferous tubules of testes. Is driven by testosterone (controlled by brain).

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**Spermatogenesis** = production of sperm in seminiferous tubules of testes.

**Spermatogonia (2n)** = primitive sperm cells that become primary spermatocytes.

↓ mitotic

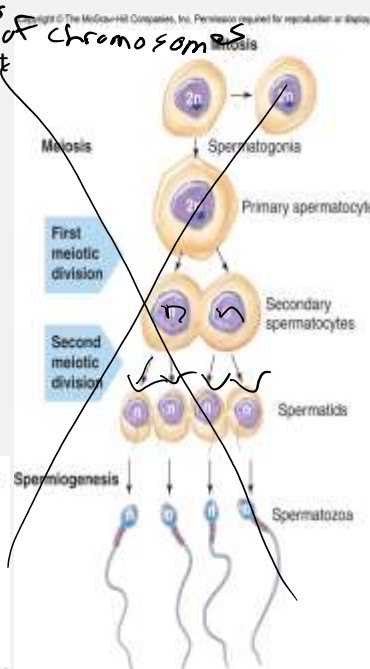
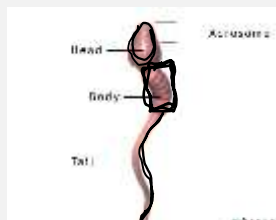
**Primary spermatocyte (2n)** = cells that undergo meiosis 1

**Secondary spermatocytes (1n)** = cells that undergo meiosis 2

**Spermatids (1n)** = immature sperm cells.

**Spermatozoa (1n)** = mature sperm cells.

Click [HERE](#) for YouTube video on spermatogenesis.



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**Male Fertility** – need ~ 20 million sperm / ml of semen. Of these sperm, 40% must have normal movement (good swimmers!) and 60% must have normal shape (morphology)

CAUSES OF MALE INFERTILITY?

(anabolic) steroid use (shuts down LH & FSH)  
don't produce sperm

Damage to testes

Benign Prostate Hyperplasia (BPH)

Poor diet, obesity, high WHR

Klinefelter syndrome (XXY)

Age

Genetics

STRESS

Smoking

Testes too warm

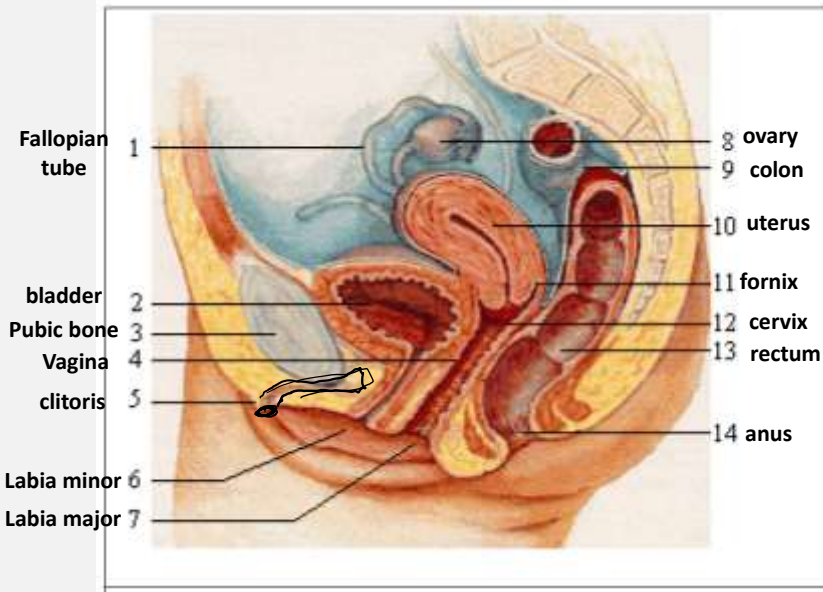
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**Review**

- Male reproductive anatomy & physiology
- - reproductive structures
- How an erection works
- BPH, prostate cancer, ED, ED drugs
- Spermatogenesis
- Male fertility and infertility

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## The Basics of Female Reproductive A & P



[The Reproductive System](#) Pgs 8 - 11

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## The Basics of Female Reproductive A & P

Ovaries = paired gonads making eggs, estrogen, & progesterone.

Vagina = muscular copulatory & birth canal.  
- outside body

### External genitalia:

> Labia = labia major & minor

> Clitoris = erectile tissue with sensory nerves (similar to head of penis)

Uterus = muscular sac capable of supporting developing fetus.

> Fallopian tubes = paired tubes that can transport fertilized egg from ovaries to uterus.

> Cervix = entryway into uterus from vagina.

> Endometrium = secretory layer of uterus. Where embryo implants

> myometrium, = muscular layer of uterus, responds to oxytocin & prostaglandin.

[The Reproductive System](#) Pgs 8 - 11

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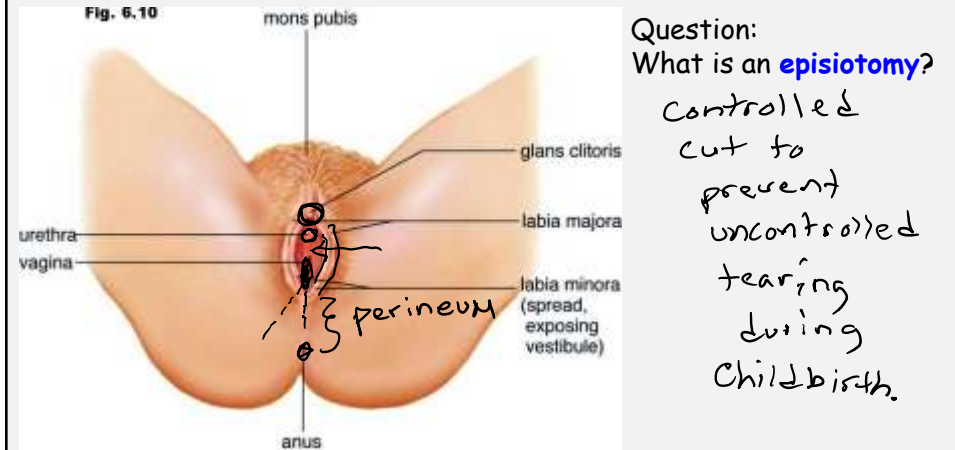
## External Genitalia

**Clitoris** = equivalent of glans penis. Same sensory nerves & erectile tissue

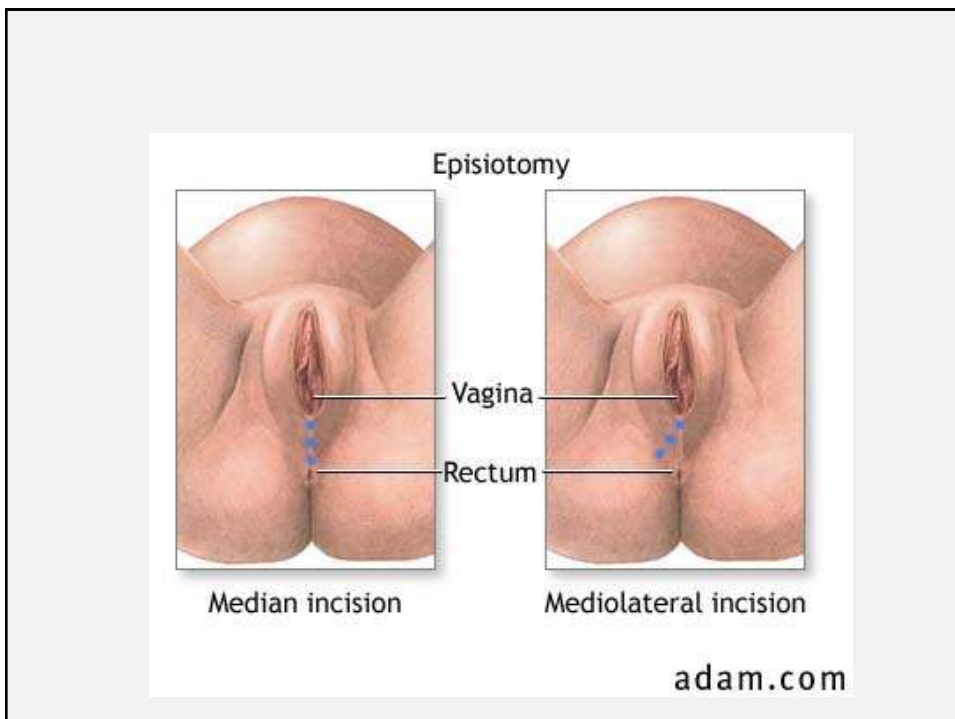
**Labia minor** = smaller inner labia

**Labia major** = larger outer labia

~~perineum = tissue surrounding urethral & vaginal openings. Prone to tearing during childbirth!~~



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Cliterectomy (see reading assignment online)  
removal  
 = surgical removal of clitoris (C in photo)

Infibulation = removal of labia minor and suturing (stitching) of labia major partially closed (narrow opening left for menstrual flow). A & B in photo. Can often include cliterectomy.

See reading assign.:  
["Genital Mutilation"](#)

A: YDRE SKAMLÆBER  
 B: INDRE SKAMLÆBER  
 C: KLITORIS

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**A. Normal**

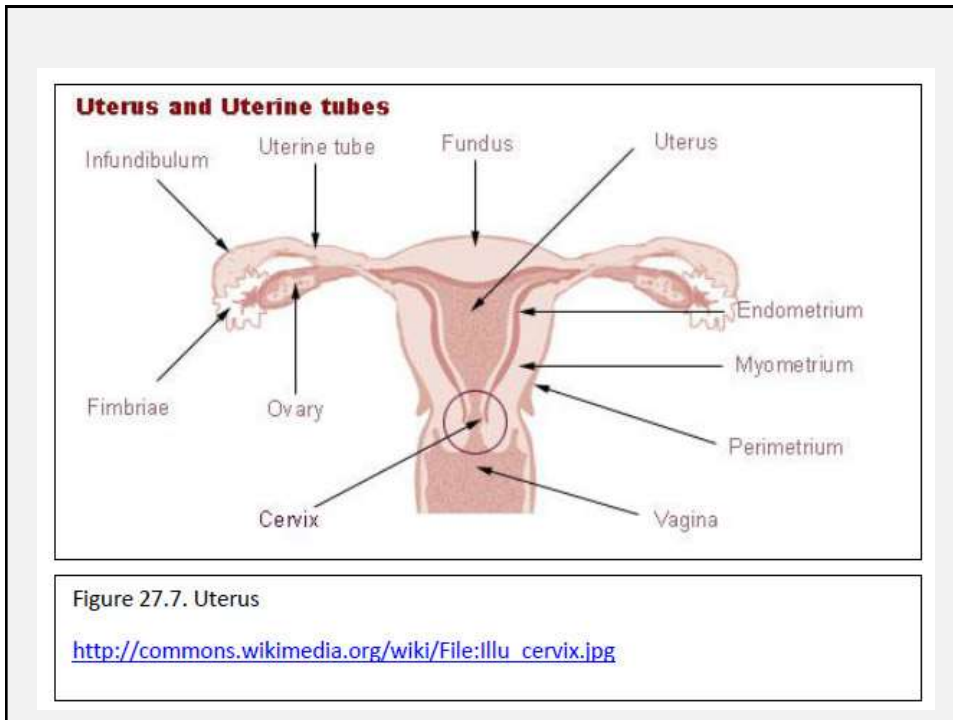
**B. TYPE I**  
 A. Prepuce removal only or  
 B. Prepuce removal and partial or total removal of the clitoris

**C. TYPE II**  
 Removal of the clitoris plus part or all of the labia minora

**D. TYPE III**  
 Removal of part or all of the labia minora, with the labia majora sewn together, covering the urethra and vagina and leaving a small hole for urine and menstrual flow

A: YDRE SKAMLÆBER  
 B: INDRE SKAMLÆBER  
 C: KLITORIS

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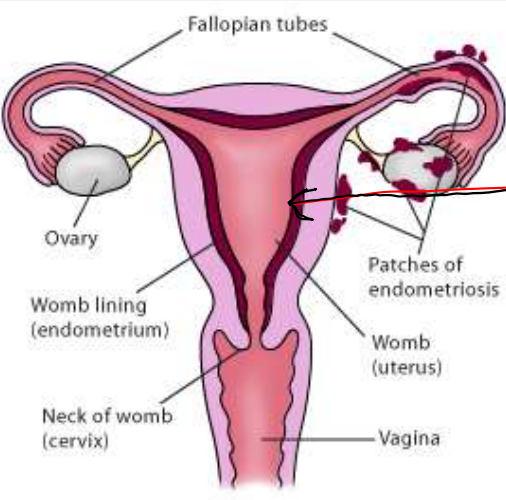
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Endometriosis = when endometrial tissue of uterus wanders out of uterus to different locations. Still responds to progesterone by proliferating, and then shedding when progesterone declines each menstrual cycle. \*Painful!

Common treatment  
hormonal birth control



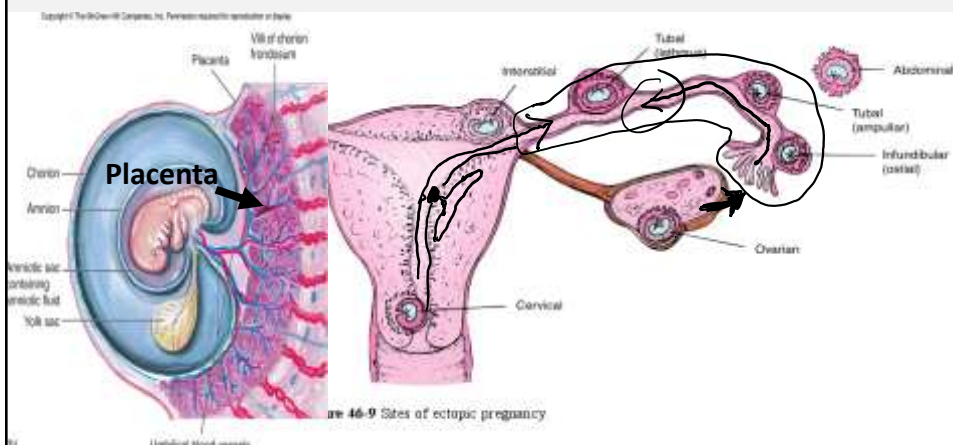
lining of uterus (endometrium) thickens due to hormone progesterone. This layer is where fertilized egg implants

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The Fallopian Tubes = tubes that transport ovulated

egg to uterus

Ectopic Pregnancy = pregnancy "out of place" (basically anywhere except within the uterus). Frequency of 2% among females.  
<http://www.aafp.org/afp/2000/0215/p1080.html>

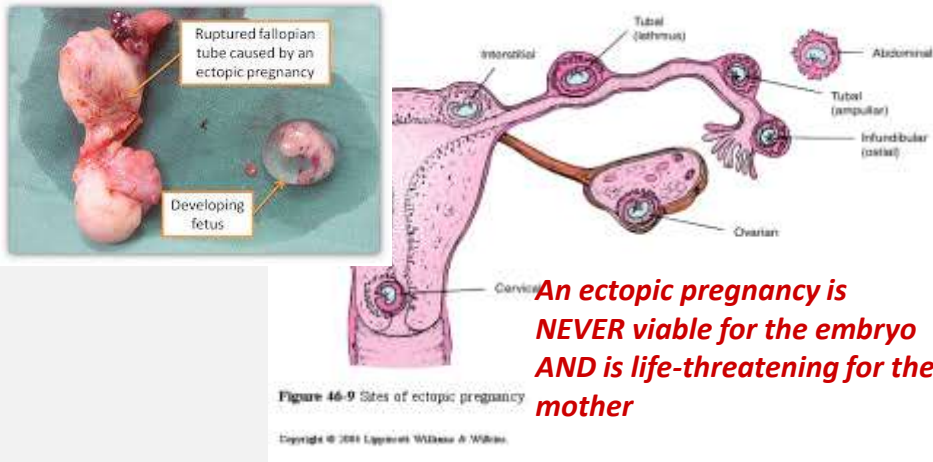


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## The Fallopian Tubes

**Danger of an ectopic pregnancy** = only the uterus & its strong ligaments can support weight of growing fetus. **Only endometrium** capable of forming a fully functional placenta. All other tissues not compatible for pregnancy. Embryo **CANNOT** survive, and mother could die (bleed out).



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## The Cervix

= entryway to uterus.

- > normally ~ 2.5 cm in diameter.
- > Can dilate during childbirth over 10 cm!

Let's look at an analogy, shall we??



**Question: What is a PAP smear?**

↳ swab surface of cervix  
& examine for abnormal cells.

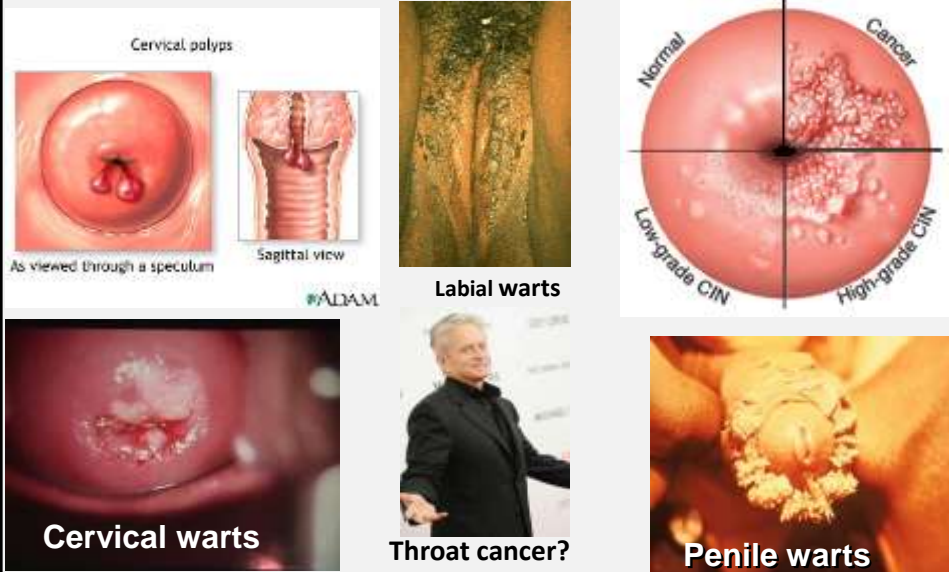


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**HPV** – human papilloma virus. Present in 50% of sexually active adult population. Can cause polyps and warts at site of contact.

Can lead to increased risk for cancer.

### Cervical cancer stages



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## HPV Vaccine - 2006

- **Gardasil** marketed by Merck & **Cervarix** by GlaxoSmithKline
- Both are set of 3 vaccinations.

### Only Gardasil is:

- Effective against 4 strains HPV – 2 which cause cancer & 2 which cause warts
- Tested & recommended for 9-26 yr old girls AND boys (younger is better - before sexual exposure!)
- Can get up to 21-26 yrs but protection goes down w/sexual exposure.


See reading assign.: Cervical cancer vaccine



Source: [www.cdc.gov/hpv/vaccine](http://www.cdc.gov/hpv/vaccine)

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Since 2018 ....



**HPV infections targeted by vaccine have decreased since vaccination was introduced\***

Among teen girls <sup>1</sup>	Among young women <sup>1</sup>
88%	81%

**HEALTH CARE PROVIDERS should recommend HPV vaccination for all patients at age 11 or 12<sup>2</sup>**

**HPV can cause some cancers in women and men  
HPV vaccination is cancer prevention**

\* HPV vaccination introduced in 2006.  
<sup>1</sup> Prevalence of HPV types targeted by the quadrivalent HPV vaccine among females aged 14-19 years and females aged 20-24 years in 2015-2018 compared with 2003-2006.  
<sup>2</sup> HPV vaccination is also recommended for everyone through age 26 years if not adequately vaccinated previously.

CDC.GOV [bit.ly/7012a2](https://www.cdc.gov/mmwr/volumes/70/wr/mm7012a2) MMWR

[https://www.cdc.gov/mmwr/volumes/70/wr/mm7012a2.htm#F1\\_down](https://www.cdc.gov/mmwr/volumes/70/wr/mm7012a2.htm#F1_down)

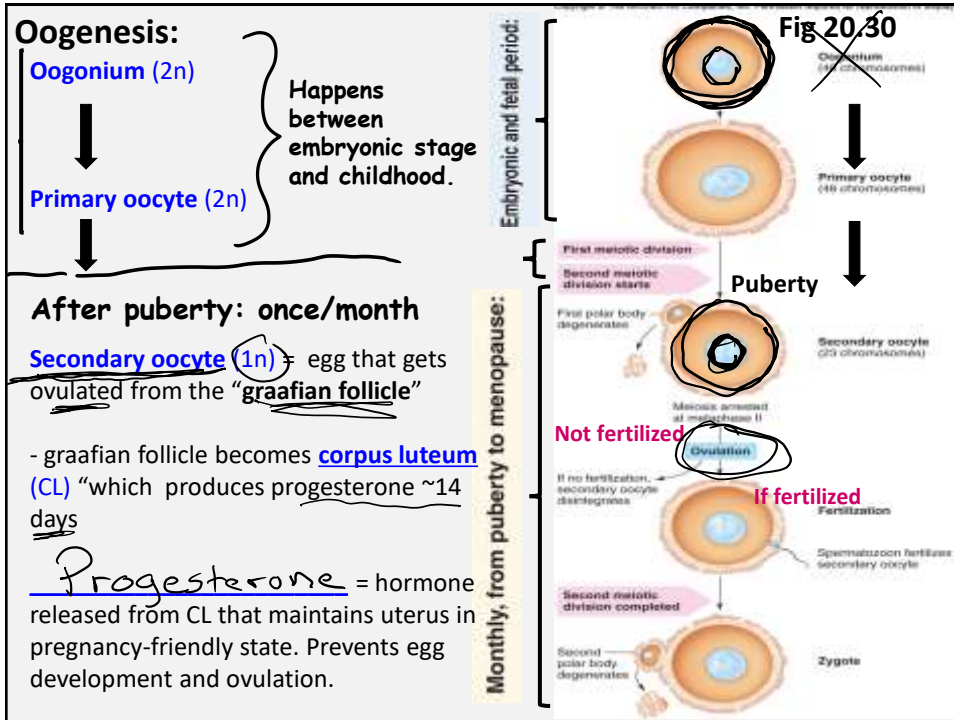
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## Maturation of eggs

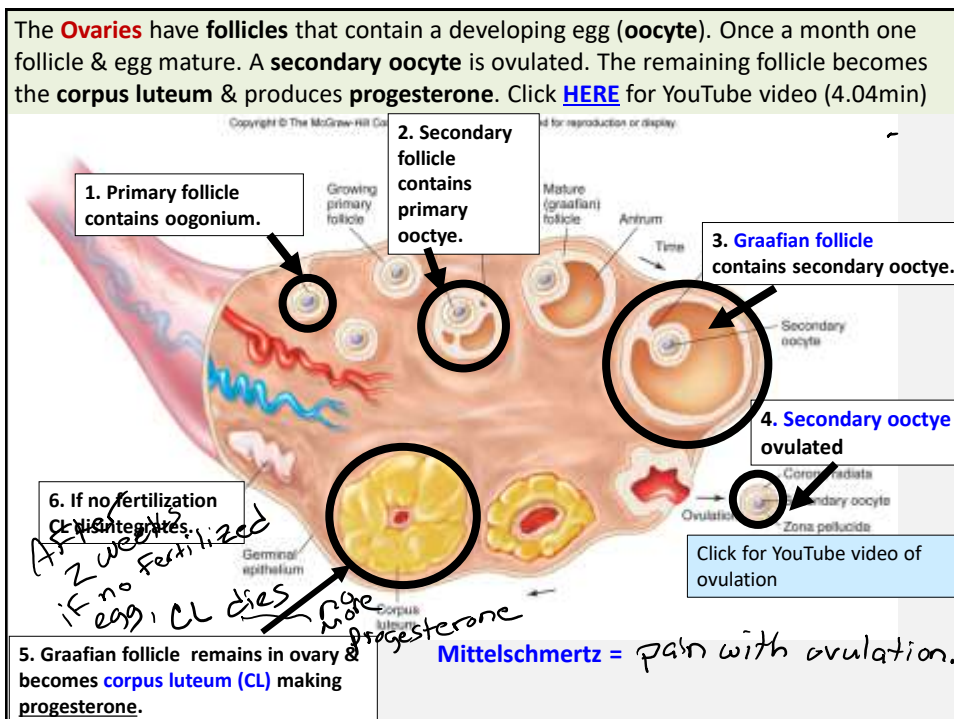
Oogenesis = production of eggs in ovaries. All the eggs a woman will ever have were in her fetal ovaries (before she was ever born!).

*Ematuration*

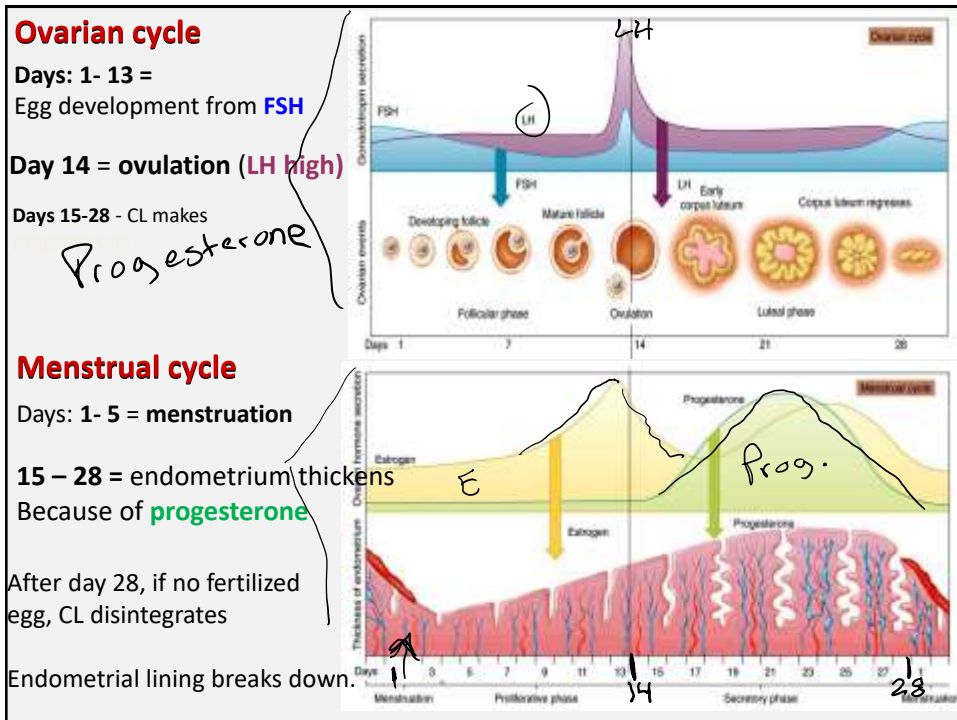
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**IF no fertilization:**

- Corpus luteum breaks down and stops progesterone secretion @day 28.
- Without progesterone, uterine lining breaks down.
- Menstrual flow – egg and lining shed
- Endometrium secretes Prostaglandin, which causes uterine cramping to expel blood and tissue. "menstrual cramp"

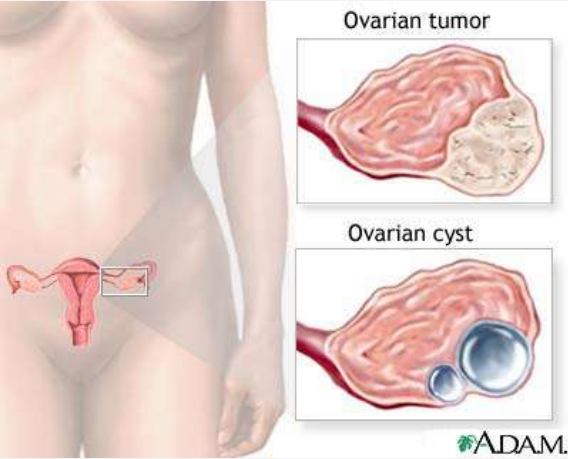
**IF fertilization:**

- Embryo makes hCG within 1 week (the hormone pregnancy tests detect this in the urine)
- This hormone "rescues" corpus luteum – it keeps making progesterone ~ 1month (until placenta forms and takes over progesterone production).

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Ovarian Cancer = condition in which follicles in ovary fill with fluid (cysts). Painful condition that decreases fertility.

Prevention: <sup>Treatment:</sup>  
 Hormonal birth control



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Ovarian cancer

↑ risk factors include:

- > Genetics (close female relative had it)
- > Have had more ovulations in life (Ovary repairs itself)
- (never been on hormonal birth control or been pregnant)
- > Have mutation in the BRCA gene
- > Polycystic ovarian syndrome
- > hormonal problems

↓ risk factors include:

- > not have genetics
- > no mutation in BRCA gene
- > fewer ovulations in life (never on birth control, never pregnant)

Question: Why do you think having been on birth control lowers risk of ovarian cancer??

have been → or pregnant  
 have been  
 shuts down ovary

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**Question: Why do you think having been on birth control lowers, or having been pregnant, decreases the risk of ovarian cancer??**

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### Ovarian and Breast Cancer and genetic predisposition:

BRCA gene = tumor suppressor gene that normally suppresses tumor growth (a good thing!)

**Mutation in this Gene** – means the gene does not suppress tumors. Mutation in this gene associated with increased risk for ovarian & breast cancer.

Can get blood test for it.

CA-125 = cancer antigen 125  
increased levels of this in blood associated with ↑ risk of ovarian cancer (separate from BRCA gene)



Angelina Jolie

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Risk of Cancer in Individuals With a BRCA1 or BRCA2 Mutation			
Cancer Type	General Population (No Mutation)	Individuals With Mutation	
		BRCA1	BRCA2
Breast	12%	50-80%	40-70%
Ovarian	1-2%	24-40%	11-18%
Male Breast	0.10%	1-2%	5-10%
Prostate	15% (N. Europe Origin)	up to 30%	up to 39%
	18% (African American)		
Pancreatic	0.50%	1-3%	2-7%

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<p><u>Menopause</u> = end of woman's reproductive cycle. Ovaries <b>suddenly</b> stop producing eggs, estrogen, &amp; progesterone (age 50 or so).</p> <p>Symptoms:</p> <ul style="list-style-type: none"> <li>&gt; moodiness</li> <li>&gt; hot flashes</li> <li>&gt; vaginal dryness</li> <li>&gt; osteoporosis (thinning of bones)</li> <li>&gt; ↑ libido (due to testosterone from adrenal glands)</li> <li>&gt; ↑ facial hair growth in some women (hirsutism)</li> </ul> <p><u>Andropause</u> = gradual decline in man's reproductive function. Testosterone and sperm production slowly decline from age 40 &amp; on.</p>
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**Fertility in Women** best from 16 – 40. Declines after 40.

**CAUSES OF FEMALE INFERTILITY:**

WHR > 0.8 - ~30% (1/3) ↓ fertility

Endometriosis

Polycystic ovarian syndrome (PCOS)  
multiple fluid filled follicles

uterine fibroids - fibrous tissue buildup  
in uterus.

Eating disorders

↑ age (menopause)

Chemotherapy

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**Review**

- Female reproductive anatomy & physiology
  - - reproductive structures
- Ectopic pregnancy, endometriosis, polycystic ovarian syndrome, episiotomy.
- HPV, warts, cervical cancer, HPV vaccine, breast & ovarian cancer, mutations in the BRCA gene, CA125 test.
- Genital mutilation
- Oogenesis
- Menstrual cycle (follicle & uterine cycles)
- Role of hCG in rescuing corpus luteum in pregnancy
- Menopause & Andropause
- Fertility and infertility in women

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