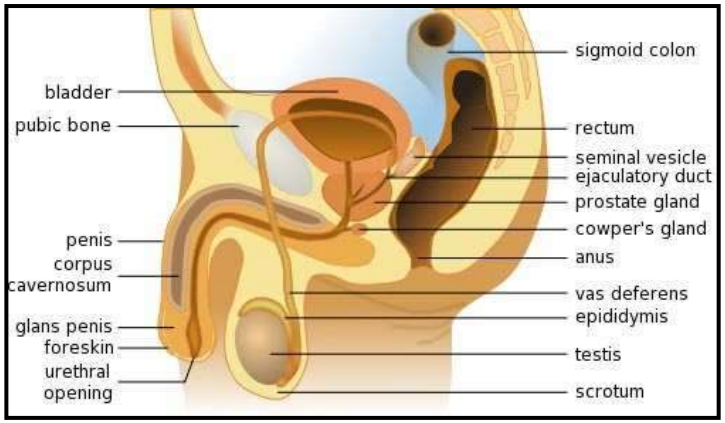
Sexual Reproduction:

- Fusion two gametes (egg and sperm)
- Male deposit sperm cells into vagina of female sexual intercourse
- Zygote develop 9 months uterus
- Plants asexual
  - New plant formed existing plant
- Plants Sexual
  - Pollen grain and ovule form seed

Male Reproductive System:



- Have copulatory system to transfer sperm
- **Scrotum**
  - Thin skinned sac houses testes
  - Temperature regulation (36 degrees Celsius to produce fertile sperm)
  - Cold: Smooth muscle contract move testes closer to abdomen warmth
  - Warm: Testes loose and suspended well away body
  - Protect
- **Testes**
  - Oval structures, suspended outside body
  - Situated in a scrotum
  - Consists many compartment/lobules, contain highly convoluted tubules: seminiferous tubules
  - Germinal epithelium lines seminiferous tubules
  - Group endocrine cells, interstitial cells (cells of leydig) found in tubules
  - Produce sperm (germinal layer) and hormone testosterone (interstitial cells)
- Ducts: **Epididymis**
  - Seminiferous tubules join to form, highly convoluted
  - Immature sperm enter Epididymis where they mature become motile/fertile
  - Stored several months
  - Sperm viable approximately 3 months, broken down by epithelial cells of epididymis and reabsorbed body

- **Sperm duct** (**vas deferens**)
  - Muscular sperm duct continuation of epididymis
  - Leaves scrotum pass through prostate gland and enter urethra
  - Push mature sperm forward by strong peristaltic wave from epididymis to urethra = **ejaculation**
- **Urethra**
  - Common duct of semen and urine
  - No worry contamination, muscle sphincter so urine and sperm cant mix
- **Penis**
  - Transfer of sperm from male into vagina female
  - Made of tissue and huge sinuses that fill with blood
  - during intercourse act as hydrostatic force as blood push against sinuses to enlarge penis so fit inside female reproductive system
- **Tip of Penis**
  - External skin close over urethra
  - Foreskin protection against bacteria (moist-HIV)
  - Lots of nerve endings (heightened awareness sex)

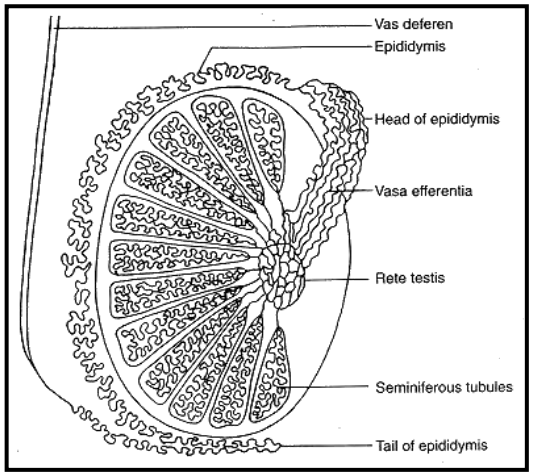
<u>Three glands contribute fluids to sperm to form semen:</u>

- **Two seminal vesicles**
  - lie between bladder/rectum
  - Join vas deferens to form ejaculatory duct enter urethra
  - Secretion provide sperm nutrients/enzymes
  - Provide sugary substance to give ATP to mitochondria in neck of sperm
- **Prostate gland**
  - Located below bladder
  - Secrete milky, alkaline fluid (buffer against women's acidic environment of vagina) that increases mobility of sperm
- **Two Cowper's glands**
  - Located either side urethra below prostate
  - Secretions stimulate mobility of sperm

Main role male reproductive system to produce sperm and hormone testosterone

Sperm combine egg-half genetic material

Male gonads (testes) develop abdominal cavity, descend into external sac (scrotum) just before birth



<u>Define:</u>

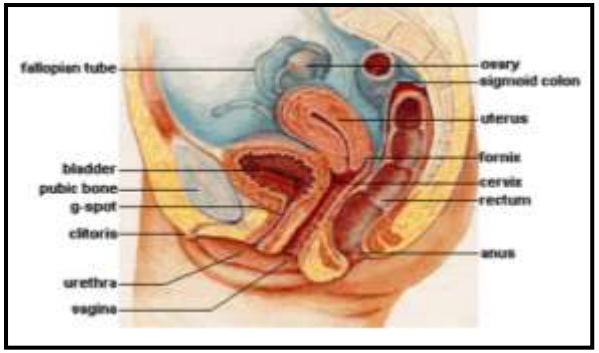
Sperm: male gametes

Semen: seminal fluid

Erection: stiffening penis (dilation arteries supplying blood to penis, more blood fill three spongy erectile tissue chambers so penis stiffens and lengthens)

Ejaculation: the expulsion of semen

Female Reproduction System:



- **Ovaries**
  - Layer of germinal epithelium surrounding each ovary
  - Primary follicles contain immature egg
  - Primary follicle develop mature follicle
  - After ovulation Graafian follicle form corpus luteum
  - Ovaries release eggs
  - Produce oestrogen, progesterone
- **Fallopian Tubes**
  - lead from each ovary to uterus
  - extensions called frimbia
  - provide pathway between uterus, ovary, egg, sperm, zygote
  - site of fertilization
  - initial cell division of zygote
  - enable egg or developing zygote to move towards uterus (action smooth muscles/cilia)

- **Uterus**
  - Muscular sac like structure where foetus develops
  - Lower part project into vagina=**cervix** (mucous plug prevent bacteria)
  - Sphincter muscles keep uterus closed
  - Uterus lined with endometrium
  - Ovulation endometrium thicken to prepare blastocyst
  - If not fertilized upper layer detaches (smooth muscle) and passed out with egg=**menstruation**
  - Organ in which blastocyst implants, develops, grows
  - Provide oxygen/nutrient and remove wastes and carbon dioxide from baby
- **Vagina**
  - Elastic folded walls allow to stretch during pregnancy
  - pH of vagina is acidic healthy/free from infection
  - exposed outside environment so stratified epithelium good protection
  - sperm deposited
  - birth canal
- **vulva**
  - two outer and inner folds of skin
  - outer folds have external surfaces covered hair, inner surface moist/smooth
  - inner folds delicate and form **clitoris**
  - clitoris small erectile structure similar male penis, many nerve endings, sexual sensation

- Female gonads suspended by ovarian ligaments in abdominal cavity
- Outside made of germinal epithelium, divide from ova in foetal stages

- **Puberty**
  - Female 400 000 potential eggs
  - Males no sperm cells produced until boy reaches puberty
  - Puberty occur earlier in girls (11-14) than boys (14-16)
  - Puberty initiated by three hormones (protein molecule, secreted in blood, travel target organ, chemical messenger control specific processes)
  - LH, FSH, HGH
- **Female**
  - Ovaries produce oestrogen, trigger changes
  - Rapid growth height
  - Hair: underarms, pubic
  - Breasts
  - Hips widen
  - Fat layer deposited
  - Metabolic rate-settle slow
  - Ovaries develop produce ova
- **Males**
  - Testes produce testosterone, trigger changes
  - Rapid, sustained growth height
  - Hair: underarms, pubic
  - Skin oiler, pimples
  - Moustache, beard
  - Voice deepen (break-squeaky)
  - Shoulders/chest broader
  - Fat replaced defined/large muscles
  - Penis/testes increase size
  - Testes make sperm

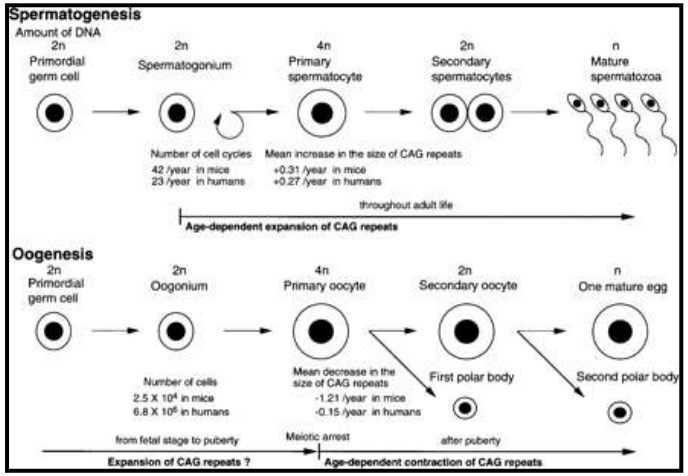
Note:

Mitosis: result two cells, each same number (2n) of chromosomes as mother cell, genetic info in both same

Meiosis: result four cells, half number (n) of chromosomes as mother cell, genetic info different due to crossing over

- **Spermatogenesis**
  - Haploid spermatozoa produced from germinal epithelium in seminiferous tubules of testes
  - Testosterone essential making sperm
- **Phases of spermatogenesis**
  - **Multiplying phase**
  - Diploid spermatogonia (2n) of germinal epithelium divide repeatedly mitosis to form new spermatogonia (2n)
  - **Growth phase**
  - Spermatogonia mature (grow, develop into primary spermatocytes)
  - **Reduction phase**
  - Primary spermatocytes undergo first meiotic division, each forming **two haploid secondary spermatocytes (n)**
  - These undergo the second meiotic division= **four haploid spermatids**
  - Sperm production balanced supply/demand
  - Spermatogenesis take 72 days from primary spermatocyte to immature sperm
  - Immature sperm moved to epididymis where mature, become motile/fertile
  - Mature sperm cells streamlined, high rate metabolism, propel selves long distance reach egg

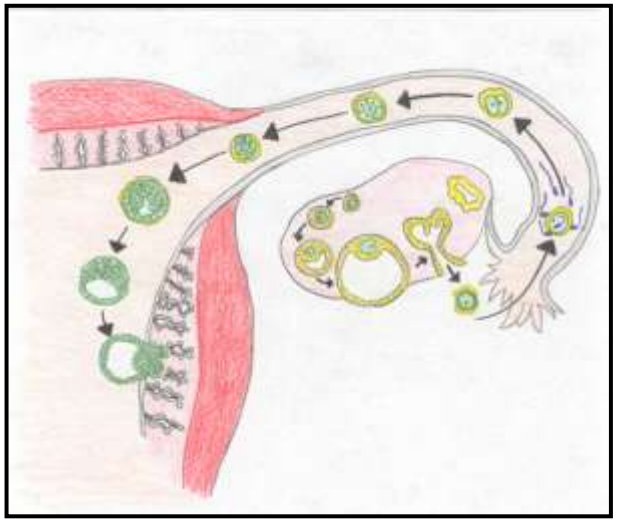
- **Oogenesis**
  - Production haploid, mature eggs in follicles of ovaries
  - Number eggs determined before birth
  - **Multiplying phase**
  - Before birth germ cells from germinal epithelium (surround ovary) sink in and divide mitosis to form primary follicles
  - Each follicle has large central oogonium (2n)
  - **Growth phase**
  - Puberty FSH released cause follicles periodically grow/develop to form Graafian follicles
  - Oogonium grow into primary oocytes
  - **Reduction and maturity phase**
  - Primary oocytes (2n) undergo meiosis form egg (n)
  - Mature Graafian follicle move periodically to surface ovary, burst, release mature egg, surrounding follicle cells



- **Menstrual Cycle**
- Occurs every 28 days
- Series of changes in endometrium
- **Menstrual and development of Graafian follicle/Follicular phase (Day 1-5):**
- Breakdown shedding endometrium of uterine wall
- No progesterone maintain endometrium
- Detached tissue and blood out through vagina as menstrual flow
- FSH is secreted from pituitary gland, target ovaries, to stimulate follicle to mature/develop (others dormant), egg mature, follicle start release more oestrogen
- **Building phase/Ovulatory phase (Day 6-14):**
- Wall of ovarian follicle become additional endocrine gland, follicle release oestrogen, target pituitary gland and uterus
- Inhibit FSH release (stop maturing follicles less mature)
- Stimulate repair of endometrium
- **NEGATIVE FEEDBACK**
- Oestrogen reach critical high stimulate release LH
- LH produced from pituitary gland, target ovary/follicle
- Cause Graafian follicle to rupture (ovulation) releasing ovum
- Approximately day 14
- **Luteal and secretory gland (after day 14):**
- Still under influence of LH empty follicle fill with yellow cells to form corpus luteum (start produce progesterone) (endocrine gland)
- Progesterone inhibit FSH/LH to stop another ovulation
- Corpus luteum produce lots of progesterone in good condition maintain pregnancy (thicken uterus, enough nutrients supply oxygen and nutrients baby)
- Corpus luteum not viable for long, shrink down (get to critical low cannot maintain endometrium, breakdown, inhibitory effect get weaker-LH/FSH)
- **Next cycle**
- **Pregnancy**
- HCG produced in fertilized egg cell target corpus luteum
- As cell divides more produce more HCG, implantation produce enough HCG
- Corpus luteum stimulate grow larger, progesterone maintain thick endometrium
- After 12 weeks corpus luteum shrivel up as placenta produce enough progesterone (can have withdrawals)

- **Fertilization**
- Copulation
  - Sperm deposited in females
- Sexual intercourse semen forced out penis powerful contraction urethra (**ejaculation**)
- Enter vagina not exposed air
- Force ejaculation force sperm into cervix, swim along walls of uterus
- Choose one of two fallopian tubes (no chemical attraction, randomness of which sperm fertilises which egg)
- Egg surrounded by follicle cells sucked into fallopian tube action fimbriae
- Spermatozoa get to top uterus in 8 seconds if female have orgasm (muscular contraction cervix)
- If sperm reach top uterus in two days rest gain small amounts of nourishment before swimming to ovum in fallopian tube (released during ovulation)
- Ovum metabolically inactive dies within 3 days
- Sperm dies within 6 days
- Millions sperm surround egg
- Digestive enzymes release from acrosome break down glycoprotein layer envelopes ovum
- One spermatozoon will penetrate fertilization membrane immediately depolarize/toughens to prevent sperm from entering ovum
- Only head region of sperm enters egg (leave mitochondria neck piece and tail outside)
- Ovum complete meiosis 2
- Contents sperm nucleus fuse egg nucleus form diploid zygote= **contraception**

- **Implantation**
- Zygote transported along fallopian tube cilliary action, start dividing mitosis within 12 hours to form cluster cells= **morula** within 4-5 days
- Morula change shape form **blastula** (hollow ball cells)
- Blastula grow tiny extensions-villi
- Day 7 enter cavity uterus sufficiently developed sink in attach to endometrium
- **Human chorionic gonadothrophin (HCG)** stimulate **corpus luteum** in ovary continue secretion progesterone maintain endometrium
- Stimulation continue at least 12 weeks
- Implantation complete by about day 14 after ovulation (should start next period)
- HCG and progesterone inhibit FSH release so preventing a new menstrual cycle

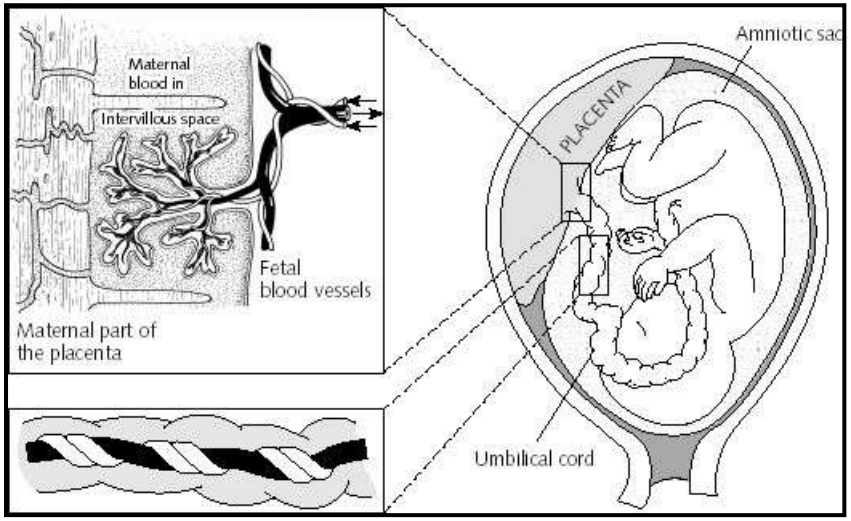


Extra Embryonic Membrane and Placenta:

- Outer layer cells of blastula develop embryonic membranes
- Allantois and yolk sac develop become incorporated **umbilical cord**
- Chorion outer membrane embryo (responsible successful implantation)
- Produce chorionic villi
- Increase surface area of chorion ensure huge contact endometrium, embryonic membranes
- Link where maternal nutrients, oxygen, antibodies exchanged with foetal wastes and carbon dioxide during pregnancy
- Chorion produce progesterone 12^{th} week (vital)
- Corpus luteum shrivels up and dies no longer producing progesterone
- If chorion not produce progesterone=spontaneous abortion (miscarriage)
- **Yolk sac**
- Initial storage site for blood production as no transport system for few weeks
- Maintain integrity embryo
- **Amnion**
- Thin very strong membrane surround embryo/foetus
- Secrete amniotic fluid
- Fluid produced recycled continuously during pregnancy so always clean, right balance substances in
- 99% water also foetal cells, microorganisms, foetal wastes
- Isotonic with tissue fluid of foetus prevent too much absorption water
- Constant 37 degrees Celsius
- Functions:
  - Cushion developing foetus any injuries
  - Shock absorber
  - Support to foetus (buoyancy) freedom move
  - Prevent malformations gravity pressure
  - Hold urine
  - Prevent dehydration
  - Rupture beginning labour lubricate birth passage (vagina) pregnancy
- **Allantois**
- Store metabolic wastes (nitrogenous waste poisonous)
- Store increase in size fuse chorion (common membrane), move through chorio-allantoic membrane to mother endometrial tissue-kidney

- **Umbilical cord**
- Form extension chorion, allantois and yolk sac
- Long flexible chord extending from abdomen
- Two foetal arteries carry wastes and carbon dioxide away foetus to placental surface
- One umbilical vein bring nutrients, oxygen and maternal antibodies from placental surface into foetus
- Rich store embryonic stem cells
  - Used to form any type of cell
  - Can be harvested stored for person
- **Placenta**
- Disc shaped organ made of rich supply connective tissue
- Weighs about 1kg
- site where exchanges mother and foetus take place
- foetal blood mothers blood DO NOT MIX
- transfer of substances occurs through very thin layers chorion and material capillaries
- villi unite into foetal arteries and vein (very close maternal blood vessels/sinuses)
- allow for very efficient rapid diffusion of substances from mother to foetus and from foetus to mother
- produce progesterone (maintain endometrium)
- act as micro-filter prevent pathogenic bacteria in mother enter foetus
- following pass across placental barrier
  - water (osmosis), carbon dioxide, urea (away foetus)
  - nutrients (glucose, amino acids, fatty acids essential ions/vit, move active transport)
  - antibodies (mother to foetus)
  - cigarette smoke, alcohol, illegal drugs, medicine, viruses (German measles) (some substances damage foetus/cause addiction born)
  - HIV/Flu **not** cross placental barrier

- **Chorion**
- Formed sufficiently successful pregnancy
- Chorion villi (extensions)
- Fuse allantois form placenta
- Cells produce HCG
  - Stimulate corpus luteum
- Villi embed, anchor implantation
- Greater surface area across which oxygen and nutrients can be exchanged
- **Time after fertilization:**
  - 7 days: embryo in uterus
  - 8-14 days: implantation
  - 6 weeks: embryo (complete fingers, eyelids, ears)
  - 8 weeks: foetus
  - 6 months: eyebrows and lashes
  - 280 days: birth



- **Antenatal care**
- Healthy diet
  - protein
  - extra calcium iron for bone and teeth
  - maternal, foetal haemoglobin
- **Avoid drugs**
  - Aspirin (reduce ability blood clot cause bleeding/miscarriage)
- **Do not smoke or drink alcohol**
  - Nicotine slow down oxygen delivery to foetus
  - Foetal Alcohol Syndrome
- **Avoid contact German Measles**
  - Pass through placental barrier (first trimester)
  - Affect foetal nervous system cause blindness, deafness, cardiac defects (hole in heart)
- **Exercise lightly**
  - Stimulate circulatory system mother

Ectopic pregnancy:

- Embryo implants fallopian tubes
- Not form placenta or accommodate growth
- Abort

- Foetus foreign tissue mother
- Carry antigens that are foreign
- Mother produce antibodies against any proteins cross placenta baby to mother

Birth (parturition):

- Expulsion of foetus, surrounding membranes, placenta from uterus
- End gestation period levels progesterone drop coincide rise oestrogen levels cause uterus muscles contract
- False labour-Braxton-Hicks contractions
- **Dilation of cervix (12 hours)**
- Progesterone levels reach critical low threshold and oestrogen reach a high threshold
- Oxytocin released pituitary gland mother-start labour
  - Sustained rhythmic contractions uterus wall
  - Oxytocin respond positive feedback-increase amounts
- Baby descends head first into pelvic girdle (head engaged)
- Mucous plug cervix comes away (show)
- Strong regular contractions of uterus get closer together
- Cervix dilates
- Amniotic fluid trapped by babies head, increase pressure cause amnion to break release amniotic fluid "breaking of waters"
- **Delivery of baby (1 hour)**
- Very strong contractions uterus forces baby through birth canal
- Head of baby emerges first (crowning)
- Short rest-right then left shoulders delivered
- Rest baby emerges
- Umbilical cord clamped two places prevent bleeding, then cut between clamps
  - Painless no nerves placenta
- Separation mother baby inflates lungs take first breath
- **Afterbirth**
- Contractions uterine wall continue until placenta detached uterine wall
- Placenta rest umbilical cord pass out vagina (afterbirth)
- **Note: Episiotomy** incision vagina towards uterus to ease expulsion baby and avoid uneven tearing

Multiple births:

- Fraternal (non identical)
  - Two or more eggs released same time during ovulation
  - Two eggs fertilized and implanted uterus
- Identical
  - Inner cell mass of blastcyst divides mitosis form to identical separate embryos develop into identical twins

Post natal care:

- Oxytocin continue to be released
  - Uterus contract down normal size
  - Stimulate release prolactin
- Combined effect hormones and sucking of baby on nipple cause mammary gland produce milk
  - Breast milk contain nutrients ideal proportions
  - Valuable antibodies
  - Correct temperature
  - Cannot cause allergies in baby
  - Deep bond mother child
  - Cheap easy
- Mothers poor communities go back to work almost immediately
  - Bottle feeding start early
  - Water contaminated germs
  - Cheap milk powder lack essential nutrients needed by baby
  - Over dilute and still too expensive
  - No immunological protection
- New born babies not able look after themselves
- Need a lot of attention
  - Keep warm cannot regulate own body temp
  - Stop breast feeding lose protection mothers antibodies, need to be protected against disease
  - Immunization projects clinics worst illness (some compulsory before school)

Birth control

- Most people cannot afford large families
- Natural
  - Withdraw penis before ejaculation
  - Intercourse not occur between day 8 and 18 menstrual cycle
- Mechanical
  - Male condom (place over erect penis before intercourse)
  - Female condom (inserted into vagina before intercourse)
  - Diaphragm (inserted over cervix by doctor)
  - IUD Intrauterine Device (inserted into uterus medical person)
- Chemical
  - Pill one per day, taken orally
  - Injection (administered medical person last 90 days)
- Surgical
  - Ligation (Female: fallopian tubes cut and tied)
  - Vasectomy (Male: sperm ducts cut and tied)