

Reproductive Physiology

Part 1 – The Basics of Reproductive Physiology

Part 2 – Female Reproductive Physiology

Part 3 – Male Reproductive Physiology

The Basics

Gametogenesis

- Gametes are produced during Meiosis I & II
 - Meiosis function
 - Production of 4 haploid (n) gametes from each diploid oögonium (2n) or spermatogonium (2n)
 - Differences between ♂ (male) and ♀ (female) gamete development
 - ♂
 - » continuous development & production of sperm from onset of puberty until....?
 - » stem cells are retained
 - » Sperm are motile and contain very little cytoplasm
 - ♀
 - » the entire complement of dictyate primary oocytes are formed during development with 10-20 continuing development during each ovarian cycle
 - » Oocytes are surrounded by follicular cells – forms ovarian follicle
 - » stem cells are exhausted
 - » oocytes are among the largest cells and are non-motile

Lecture Outline

- The Basics
 - Gametogenesis
 - Gender determination
- The Pituitary-Gonad Axis
- Female Reproductive Physiology
 - Ovarian Cycle
 - Uterine Cycle
 - Hormonal control and changes
- Male Reproductive Physiology

The Basics

Gametogenesis

- Sperm Production
 - During development germ cells are produced
 - Remain quiescent until puberty
 - Actions of hormones from pituitary, sertoli cells and Leydig cells
 - At puberty some spermatogonia will
 - Undergo mitosis continuously
 - Enter into meiosis
 - » This ensures a continuous supply of spermatogonia

The Basics

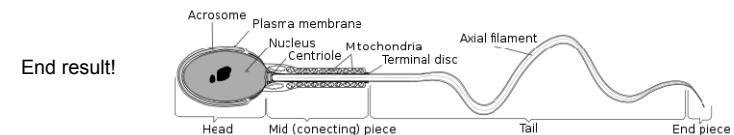
Gametogenesis

- Process of sperm production involves three stages
 1. Spermatocytogenesis
 - produces secondary spermatocytes from spermatogonium
 2. Spermatidogenesis
 - stage where meiosis I & II occur
 - results in spermatid formation
 3. Spermiogenesis
 - final stage of sperm development
 - spermatid becomes a motile spermatozoa during spermiation

The Basics

Gametogenesis

- Spermiation
 - The spermatozoa that are formed are initially unable to move.
 - The flagella must become motile
 - Not used however until ejaculated
 - Prior movement through the male reproductive tract is via peristalsis



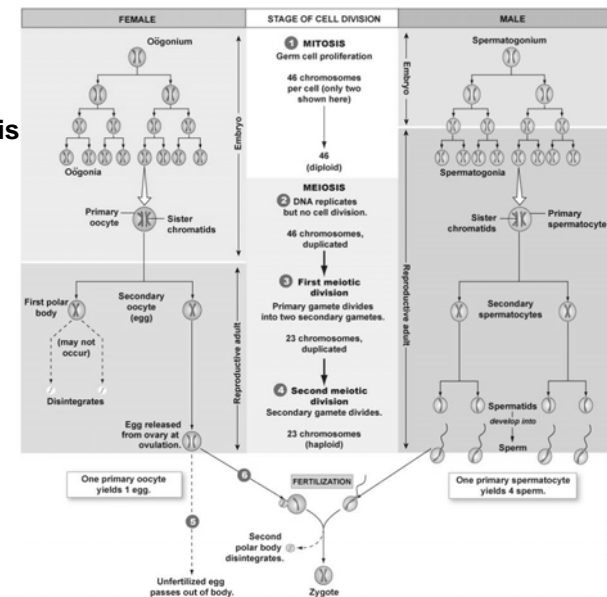
The Basics

Gametogenesis

- Oogenesis
 - Results in formation of secondary oocyte which is released during ovulation
 - If no fertilization occurs, meiosis II will not occur.
 - Stages of oogenesis
 1. Oöcytogenesis
 - Forms oögonia
 - During fetal development starting at week 10 and completing around birth
 - Results in formation of primary oocytes (~1/2 million)
 2. Ootidogenesis
 - Results in the formation of secondary oocytes
 - These are dictyate in prophase I
 3. Formation of ovum (if fertilization occurs)

The Basics

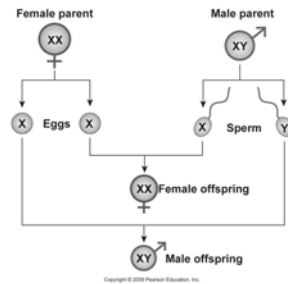
Gametogenesis



The Basics

Gender Determination

- Chromosomes determine gender
 - 23 donated by egg (n)
 - 23 donated by sperm (n)
- Syngamy
 - The fusion of gametes to form a zygote
 - Consists of
 - plasmogamy
 - union of cell membranes and cytosol
 - karyogamy
 - union of genetic material
 - Autosomes: 44 or 22 pair
 - Sex chromosomes: 2 or 1 pair
 - XX chromosomes = female
 - XY chromosomes = male



What happens if karyogamy of sex chromosomes is different?

The Basics

Gender Determination

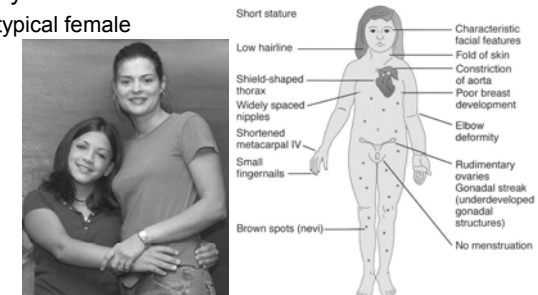
- Non-disjunction during meiosis I or II
 - Polyploidy
 - The incomplete separation of homologues during meiosis results in a zygote with too many chromosomes
 - Regarding the sex chromosomes, it may be
 - XXY (47 chromosomes total)
 - Klinefelter syndrome: Male sex organs; unusually small testes, sterile. Breast enlargement and other feminine body characteristics. Normal intelligence.
 - XYY
 - Jacob's syndrome: Individuals are somewhat taller than average and often have below normal intelligence. At one time (~1970s), it was thought that these men were likely to be criminally aggressive, but this hypothesis has been disproven over time.
 - XXYY – male and very rare (48 chromosomes)
 - XXX (Trisomy X)
 - Individuals are female normal, undistinguishable except for by karyotype.

The Basics

Gender Determination

- Non-disjunction during meiosis I or II
 - Monosomy or polyploidy
 - XO (no Y chromosome, or second X)
 - Turner's syndrome
 - Phenotypic female

What about YO monosomy?



The Basics

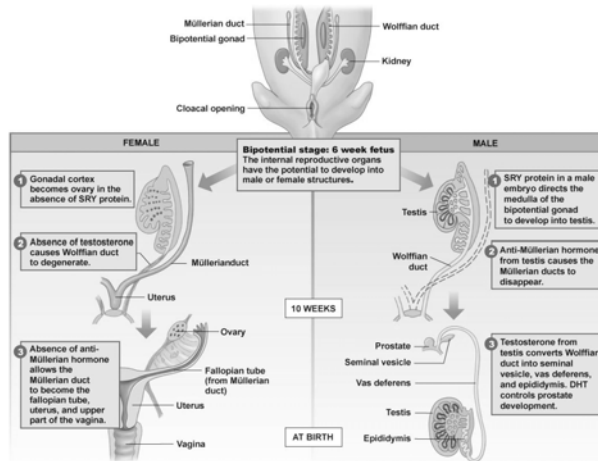
Gender Determination

- The embryo exhibits gender bipotential
 - Around week seven of fetal development the SRY (Sex-determining Region of Y chromosome) gene becomes activated
 - The SRY directs the bipotential gonads
 - The absence of this on the X chromosome causes the gonads to develop into ovaries
 - Ovaries then produce further gender biased hormones
 - The presence of this gene and its products causes the gonads to descend and develop into testes
 - Testes then produce further gender biased hormones
 - Translocation of the gene to X chromosome results in an XX individual (genotype) but with XY characteristics (phenotype)

The Basics

Gender Determination

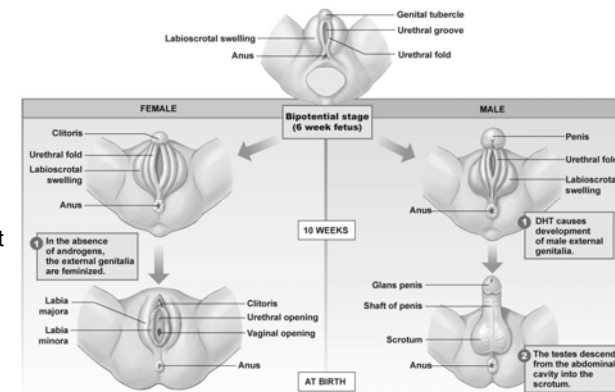
Effects of
SRY on sex
organ
development



The Basics

Gender Determination

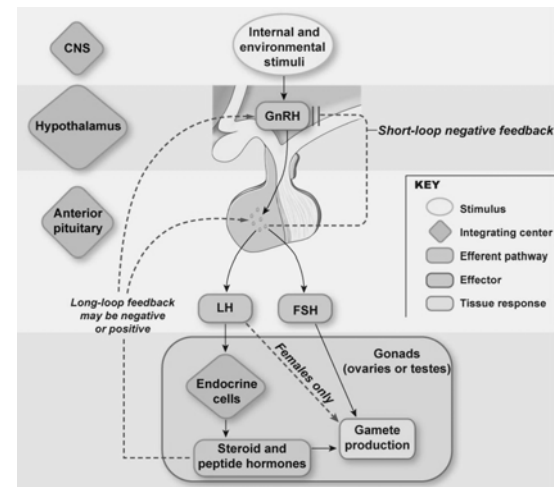
Indirect
effects of
SRY on
male and
female
genital
development



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The Pituitary-Gonad Axis



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Female Reproductive Physiology

The Cycles

- Three Phases of the Ovarian Cycle
 - Follicular phase
 - Ovulation phase
 - Luteal phase
- Three Phases of the Uterine Cycle
 - Menses
 - Proliferative Phase
 - Secretory Phase
- These ovarian and uterine phases are intimately linked together by the production and release of hormones

Female Reproductive Physiology

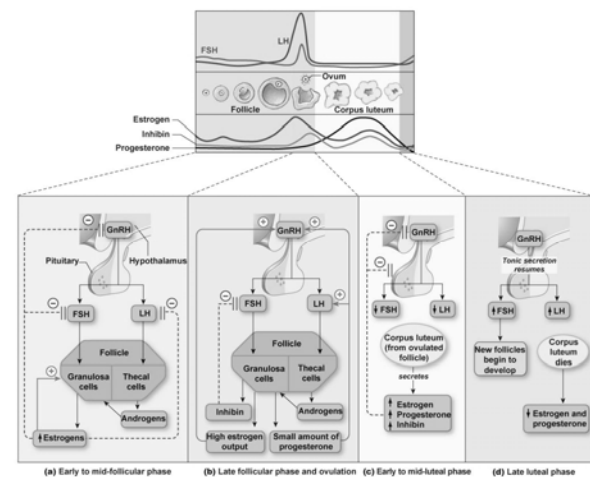
Basics

- The hypothalamus-pituitary-gonad axis controls the required physiologic changes that occur both in the ovaries and in the uterus of the menstrual cycle.
- The Menstrual Cycle
 - Duration
 - Approximately 28 days (ranges 24 – 35 days)
 - Starts with the removal of the endometrium & release of FSH by the anterior pituitary
 - The ovarian cycle
 - Development of ovarian follicle
 - Production of hormones
 - Release of ovum during ovulation
 - The uterine cycle
 - Removal of endometrium from prior uterine cycle
 - Preparation for implantation of embryo under the influence of ovarian hormones

Female Reproductive Physiology

The Cycles

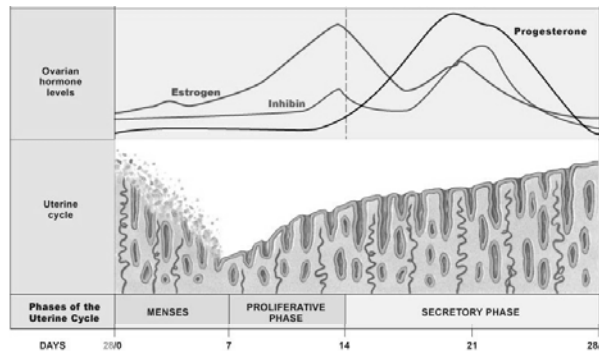
Hormonal control of the ovarian cycle



Female Reproductive Physiology

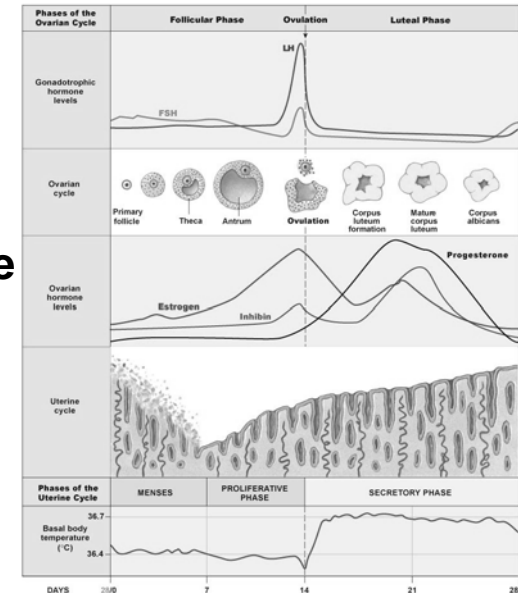
The Cycles

Hormonal control of the uterine cycle



Female Reproductive Physiology

All together



Female Reproductive Physiology

Fertilization Effects

- What happens if fertilization occurs?
 - Uterine endometrium is maintained by
 - First the release of progesterone from the corpus luteum,
 - then the release of hCG (human chorionic gonadotropin) which maintains the corpus luteum until the 7th week,
 - From 7th week on, the placenta produces progesterone which continues to maintain the endometrium & the corpus luteum degenerates
 - Placenta also produces estrogen and progesterone which at high levels blocks GnRH
 - » Estrogen is also involved in breast development
 - » Progesterone is also involved in uterine maintenance and relaxation (prevents premature contractions)
 - Placenta also produces hPL (human placental lactogen)
 - Implicated in breast development and milk production
 - » Though determined not the only factor as lack of hPL has no ill effects
 - More important is the role hPL plays in fetal nutrition by altering maternal glucose and fatty acid metabolism

Female Reproductive Physiology

Fertilization Effects

- What changes occur to allow parturition?
 - Increasing levels of corticotropin-releasing hormone (CRH) from the placenta a few weeks prior to delivery
 - Early deliveries have been linked to early elevated levels of CRH
 - During delivery
 - progesterone levels drop off
 - Oxytocin levels rise
 - » Oxytocin receptors on the uterus are upregulated during gestation
 - Inhibin levels increase
 - » Relax the cervix and ligaments of the pelvis
 - » Allows for increased stretch of the cervix which triggers additional oxytocin which triggers stronger uterine contractions which increase stretch of the cervix which triggers oxytocin which triggers stronger uterine contractions which increases stretch of the cervix which increases oxytocin release which increases uterine contractions which increases stretch on cervix which....

Female Reproductive Physiology

One possible Outcome

