Human Reproduction

- Males & Females
- Embryonic Development
- Family planning

The male reproductive system

- Designed for the continuous production of a large number of sperm
- Produces testosterone, the male sex hormone

Sperm cells

- Highly specialized for their role in fertilization
- **Head**: contains the nucleus
- **Acrosome**: contains enzymes to digest a passage to the egg
- **Mitochondria**: function?
- **Tail**: for movement

Spermatogenesis

- The testis is packed with tightly coiled seminiferous tubules
- Sperm production, or spermatogenesis, takes place inside the tubules
  - Spermatogenesis begins in germ line cells on the outside of the tubule

Spermatogenesis

- Sperm cells are made in the testis
- Develop motility in the epididymis
- Delivered to the vas deferens
- When sperm is ejaculated it travels from the vas deferens to the urethra

Spermatogenesis

- Sperm leave the penis in a fluid called semen
- Various glands (semenal vesicle, prostate gland and Cowper’s gland) add fluids which help nourish the sperm
Sperm delivery system
- The penis contains 3 long cylinders of spongy tissue
- It is designed to inflate
- Nerve impulses cause the blood vessels leading into this tissue to expand
- Blood collects in the spongy tissue and causes the penis to become erect and rigid
- Continued stimulation is required for ejaculation

Hormones control the male reproductive system
- The pituitary gland secretes 2 hormones, FSH and LH
- FSH stimulates sperm formation
- LH stimulates the testis to produce testosterone

Testosterone
- Develops male sex characteristics
  - Enlarges the sex organs
  - Body hair, beard
  - Voice change
- Develops sexual function
  - Sex drive (libido)
  - Sperm maturation
- Stimulates bone and muscle growth

The female reproductive system
- Designed to
  - Produce 1 egg each month
  - Prepare the uterus for implantation of the fertilized egg

Anatomy of the female reproductive system
- The eggs, or ova, mature in the ovaries
- The fallopian tubes transport egg to the uterus
- The uterus is lined with epithelial tissue called the endometrium
  - The surface of the endometrium is shed during menstruation
- The uterus narrows to a muscular “neck” called the cervix
- The vagina leads from the uterus to the external genitalia

The Female Reproductive Cycle
- The female reproductive cycle is actually two cycles in one:
  - The ovarian cycle
    - Ovaries release 1 egg each month
    - Coordinated by FSH and LH
  - The menstrual cycle
    - Prepares the uterus for possible implantation of fertilized egg
    - Coordinated by estrogens and progesterone
Ovulation – only 1 egg matures each month

- Ovulation: the mature follicle discharges the egg
- The egg is swept up into the Fallopian tube, where fertilization may occur

FSH and LH coordinate the ovarian cycle

- FSH stimulates the growth and maturation of a follicle
- The follicle cells secrete estrogen into the bloodstream

FSH and LH coordinate the ovarian cycle

- Estrogen levels peak at 12 days
- This causes LH levels to surge
- And stimulates ovulation at 14 days
- The mature follicle bursts and releases an egg

FSH and LH coordinate the ovarian cycle

- LH (luteinizing hormone) stimulates
  - Formation of the corpus luteum
  - Secretion of progesterone and estrogens
- If the egg is not fertilized, the corpus luteum breaks down

The uterine (menstrual) cycle

- Rising levels of progesterone and estrogens promote thickening of the endometrium
- When the corpus luteum breaks down → drop in levels of these hormones
- Endometrium begins to shed – menstruation
What is the function of FSH in males and females?

**Males**
- Secreted by the pituitary gland
- Stimulates the germinal cells in the seminiferous tubules to form sperm

**Females**
- Secreted by the pituitary gland
- Stimulates the follicles in the ovaries to form mature eggs

What is the function of LH?

**Males**
- Causes ovulation
- Stimulates the secretion of estrogen and progesterone by the ovary

**Females**
- Stimulates the secretion of testosterone by interstitial cells in the testes

Embryonic Development

The process of fertilization

Only one sperm reaches the egg

The egg’s journey

- **Fertilization** takes place in the Fallopian tube
- The fertilized egg begins a series of cell divisions called cleavage
- It eventually forms a ball of cells called a **blastocyst** which implants in the lining of the uterus

What prevents menstruation?

- The implanted embryo secretes a hormone, human chorionic gonadotropin (hCG)
- Because hCG comes from the embryo and not from the mother, pregnancy tests measure hCG
- Ovary continues to secrete estrogen and progesterone
- Prevents menstruation
Stages of early development
- Fertilization
- Cleavage
- Implantation of the blastocyst (day 7)
- Neural tube forms (days 16-25)
  - the first tissue to develop
- Organogenesis (4 weeks)
  - Formation of body organs

Fetal Development: forming organs
- Begins in the 4th week of pregnancy
  - This is a crucial time
  - Most spontaneous abortions (or miscarriages) occur during this period
- Alcohol use during pregnancy is one of the leading causes of birth defects, producing fetal alcohol syndrome

Fetal Development: the first trimester
- Development is essentially complete at the end of the third month of pregnancy
  - All the major organs are present
  - Arms and legs begin to move
  - The developing human is now referred to as a fetus

Fetal Development: the 2nd trimester
- A time of growth
  - During the 4th month, the bones enlarge
  - Mother can feel baby kicking
  - By the end of month 6, the fetus can survive outside the uterus with special medical care

Fetal Development: the 3rd trimester
- Rapid growth
  - The weight of the fetus doubles
  - Brain and lungs complete development

The placenta
- Passes oxygen and nutrients from the mother’s blood into the fetal blood supply
  - But maternal and fetal blood don’t mix
- Synthesizes hormones required to maintain pregnancy
Childbirth

- The birth of a child is brought about by a series of strong, rhythmic contractions of the uterus called labor
- Labor is induced by a strong surge of 3 hormones

Birth control

- Contraception methods differ in their effectiveness
  - Most effective
    - Sterilization (vasectomy, tubal ligation)
    - IUD
    - Implant
  - Least effective
    - Withdrawal
    - Spermicides
  - See Birth control effectiveness chart on Planned Parenthood website

How do hormones prevent ovulation?

- Female sex hormones coordinate the reproductive cycle
  - FSH and LH → Ovulation
  - Estrogen and progesterone → prepare the uterine lining for implantation
- Birth control pills contain estrogen and progestin
  - Turn off production of FSH and LH
  - Prevent ovulation

Recap: How different birth control methods work

- Prevent ovulation
  - Hormone methods – Implant, birth control pill, shot, ring, and patch; Plan B; breast feeding
  - Prevent implantation of embryo
    - IUD
  - Block or kill sperm
    - IUD, condom, diaphragm, spermicidal jellies
  - Sterilization
  - Which of these prevent STIs?
  - Which are the woman’s responsibility?

Plan B (morning after pill)

- What is Plan B?
  - Emergency contraception
  - Should be taken within 3 days after intercourse
  - Plan B contains only progestin, a synthetic hormone used in birth control pills

How does Plan B work?

- Stops ovulation
  - may prevent fertilization and implantation
- But ...
  - Plan B will not work after the fertilized egg is implanted.