Production of Sex Cells

- **Meiosis**: reduces chromosome number to half the diploid number (full set) or to the haploid number.

In humans:
- Full set—46 or 23 pairs of chromosomes
- Diploid or 2n
- Half set—23 individual chromosomes
- Haploid or n

Meiosis, the process by which gametes are formed, can also be called *gametogenesis*, literally “creation of gametes.” The specific type of meiosis that forms sperm is called spermatogenesis, while the formation of egg cells, or ova, is called oogenesis. The most important thing you need to remember about both processes is that they occur through meiosis, but there are a few specific distinctions between them.

**Spermatogenesis—production of sperm cells**

The male testes have tiny tubules containing diploid cells called spermatogonium that mature to become sperm. The basic function of spermatogenesis is to turn each one of the diploid spermatogonium into four haploid sperm cells. It will yield four cells containing a unique set of 23 single chromosomes that ultimately mature into four sperm cells (viable for fertilization). Starting at puberty, a male will produce literally millions of sperm every single day for the rest of his life.
Oogenesis—production of ova

Just like spermatogenesis, oogenesis involves the formation of haploid cells from an original diploid cell, called a primary oocyte, through meiosis. The female ovaries contain the primary oocytes. There are two major differences between the male and female production of gametes. First of all, oogenesis only leads to the production of one final ovum, or egg cell, from each primary oocyte (in contrast to the four sperm that are generated from every spermatogonium). Of the four daughter cells that are produced when the primary oocyte divides meiotically, three come out much smaller than the fourth. These smaller cells, called polar bodies, eventually disintegrate, leaving only the larger ovum as the final product of oogenesis. The production of one egg cell via oogenesis normally occurs only once a month, from puberty to menopause.

Ovulation & Insemination

- **Ovulation**: release of mature ovum from follicle of ovary into fallopian tubes

- **Insemination**: seminal fluid is released from the male urethra into the female vagina

**Fertilization**

- **Union** of the ovum and sperm

- Only one sperm cell can enter, even though it takes hundreds to break through the outer layer of the ovum

- 23 chromosomes of the ovum and sperm combine to form 46, a full diploid set

- How many days is it possible to fertilize an ovum in an average 28 day menstrual cycle??
  - Ovulation usually occurs on day 14

- The ovum can survive about 24 hours if not fertilized.
- Sperm can last between **3-5 days** in the female reproductive tract.

**Female Reproductive Diagram**

1. About once a month, one of the ovaries releases an ovum.
2. The ovum moves through the fallopian tube toward the uterus.
3. If fertilization occurs, the fertilized ovum will develop in the uterus.

**Male Reproductive Diagram**

1. Sperm are produced in the testes and are stored in the epididymis.
2. Sperm move through each vas deferens and into the urethra.
3. Sperm leave the body through the urethra, which passes through the penis.
4. Urinary bladder
5. Sperm leave the body through the urethra, which passes through the penis.
**Embryology**
- Science of the development of the individual **before birth**

- Zygote starts to divide (cleave) immediately and within 3 hours becomes a solid ball of cells: **Morula**

- Within 10 hours, morula becomes a hollow ball of cells: **Blastocyst**
  - Implants in the **uterine** lining

- Structures begin to form:
  - **Yolk sac**— produces blood cells
  - **Amniotic cavity**— becomes fluid filled
  - **Chorion**— becomes important part of placenta

- **Placenta**— anchors fetus
  - site of exchange of nutrients & wastes between mother & fetus
  - secretes hormones to stimulate release of other hormones

**Fetal Growth**
- **Fetus**
  - At 60 days embryo becomes a **fetus**

- Fetal period
  - From day 60 to birth is rapid growth
    - **Lanugo**
      - Fine soft hair covering
    - **Vernix caseosa**
      - Waxy coat of protection

**Prenatal Development**
- Begins at the time of **fertilization** until **birth** about 39 weeks later
- From conception to birth
  - 3 **Stages**
    - **Germinal** period
1st 2 weeks of development during formation of primitive germ layers

- **Embryonic period**
  - 2nd to end of 8th week, organ systems develop

- **Fetal period**
  - Last 30 weeks, organ systems grow and mature

### Periods of Development

- **Trimester**—3, 3-month segments

  - **1st Trimester**
    - After fertilization, zygote changes & for 8 weeks is: embryo
    - Weeks 8-39, zygote is now: fetus
    - Day 35, heart beats, eyes & limbs are visible
    - At end of the 1st trimester, sex can be identified 😊

  - **2nd Trimester**
    - All organ systems are formed & functioning
    - Refinement of organs & features

  - **3rd Trimester**
    - **Growth**
    - Fetus can triple weight

### Formation of the Primary Germ Layers

- Will become different organs & parts

  - **Endoderm**: lining of respiratory tract & GI tract
    - Linings of pancreatic, hepatic, & urinary ducts
    - Various glands

  - **Mesoderm**: middle layer
    - Dermis of skin
    - Most muscles & bones
    - Many glands
    - Kidneys & gonads
    - Components of circulatory system
**Ectoderm:** outer layer
- Epidermis of skin
- Cornea & lens
- Muscles & bones of face
- Brain & spinal cord

**Types of “Genesis”**

- **Histogenesis:**
  - process by which the primary germ layers develop into different tissues

- **Organogenesis:**
  - tissues arrange themselves into organs

**Parturition & Labor**

- **Parturition**
  - Process by which a baby is born

- **Labor**
  - First stage
    - Onset of regular uterine contraction until cervix dilates to fetal head diameter (1cm-10cm)
  - Second stage
    - From maximum cervical dilation until baby exits vagina
  - Third stage
    - Expulsion of placenta from uterus
  - Usually lasts between **6–24 hrs.**
  - Problems: **cesarean section** may be need (taken through abdomen)

**Changes at Birth**

- **Respiratory System & Circulatory System**
  - Foramen ovale closes, two atria separated
  - Ductus arteriosus closed, blood no longer flows between pulmonary trunk and aorta
  - Umbilical vein and arteries degenerate
Digestive System

- Meconium (anal discharge) is mixture of cells from digestive tract, amniotic fluid, bile, and mucus excreted by newborn
- Stomach begin to secrete acid
- Liver does not form adult bilirubin for 1st 2 weeks
- Lactose can be digested, but other food must be gradually introduced

Apgar Scores

Assessment of newborn baby

- Appearance, Pulse, Grimace, Activity, Respiratory effect
- Rated on scale of 0-2, 2 denotes normal function
- Total Apgar Score is sum from five characteristics

<table>
<thead>
<tr>
<th>Table 29.3 Examples of Apgar Rating Scales</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
</tr>
<tr>
<td>Appearance (skin color)</td>
</tr>
<tr>
<td>Pulse (rate)</td>
</tr>
<tr>
<td>Grimace (reflexive grimace initiated by stimulating the plantar surface of the food)</td>
</tr>
<tr>
<td>Activity (muscle tone)</td>
</tr>
<tr>
<td>Respiratory effort (amount of respiratory activity)</td>
</tr>
</tbody>
</table>

Disorders

- Ectopic pregnancy: blastocyst is implanted in an area other than the uterus—tubal pregnancy

- Fetal death

- Miscarriage: loss of embryo or fetus before the 20th week—spontaneous abortion
  - After 20th week, the loss of the infant—stillbirth

- Congenital disorders: any abnormality present at birth

Multiple Births

- Identical twins—splitting of a zygote into 2
  - Usually share a placenta but have their own umbilical cord

- Fraternal twins—fertilization of 2 ova by different sperm
  - More than one ova released at ovulation
  - Inherited trait or due to fertility drugs
Postnatal periods

- **Infancy**: birth — 18 months
  - Respiration increases due to CO2
  - Birth weight doubles in 4 months & triples in a year
  - Length will increase 50% by the 12th month
  - Rapid development of nervous & muscular systems

- **Childhood**: end of infancy to sexual maturity (puberty)
  - Growth continues, but not as rapid

- **Adolescence**: teenage years (13-19)
  - Intense physical growth
  - Secondary sex characteristics

- **Adulthood**: end of many developmental changes
  - Maturation of bone; closing of growth plates
  - Normal balding patterns
  - Maintenance of existing body tissues

- **Older adulthood**: cells fail to be replaced due to:
  - Nutrition
  - Injury
  - Disease
  - Environmental factors
  - Aging genes
  - Cells have reached their limit of reproduction
  - Aging viruses
  - Autoimmune system

**Senescence—Older Adulthood**

- Changes in skeleton:
  - Bones develop “shaggy” borders: will restrict movement
  - Changes in calcification will result in smaller or porous bones
  - Joint diseases: osteoarthritis

- Changes in integumentary:
  - Skin becomes thin & inelastic
  - Pigmentation
- Loss of hair

- Changes in cardiovascular:
  - Fatty deposits build up in blood vessel walls—atherosclerosis
  - Hardening of arteries—arteriosclerosis
  - Hypertension—high blood pressure
  - Stroke

- Changes in respiration:
  - Costal cartilage becomes calcified & reduces ability of ribcage to expand
  - Ribs become fixed to sternum, ribcage in expanded position—barrel chest
  - Muscle tissue gets scarred & reduces strength for inspiration & expiration

- Changes in urinary system:
  - Nephrons reduce in number by 50%
  - Reduction in function
  - Muscle atrophy reduces ability to empty completely & voluntary functions

- Changes in special senses:
  - Lens in the eye becomes hard & loses elasticity
  - Most people are farsighted by age 65
  - Loss of transparency of the lens—cataract
  - Glaucoma—pressure increase in eye
  - Loss of hair in Organ of Corti
  - Ossicles become more fixed & less able to vibrate
  - Taste buds replaced with connective tissue
  - Only about 40% functional at age 75

- Changes in reproductive system:
  - Women: undergo menopause between ages 45-60
    - Stopping of reproductive cycle
    - Hot flashes due to hormonal changes
    - No menstruation
    - Decrease in estrogen can cause osteoporosis
  - Men: can continue to produce gametes
    - The urge for sex decreases
    - The ability to perform the sex act decreases