Slide 2

Uterine (Menstrual) Cycle
- Cyclic changes of the endometrium
- Regulated by cyclic production of estrogens and progesterone
- FSH and LH regulate the production of estrogens and progesterone
- Both female cycles are about 28 days in length
- Ovulation typically occurs about midway through cycle on day 14

Slide 3

Uterine (Menstrual) Cycle
- Stages of the menstrual cycle
  - Menstrual phase
  - Proliferative stage
  - Secretory stage

Slide 4

Uterine (Menstrual) Cycle
- Menstrual phase
  - Days 1–5
  - Functional layer of the endometrium is sloughed
  - Bleeding occurs for 3–5 days
  - By day 5, growing ovarian follicles are producing more estrogen

Slide 5

Uterine (Menstrual) Cycle
- Proliferative stage
  - Days 6–14
  - Regeneration of functional layer of the endometrium
  - Estrogen levels rise
  - Ovulation occurs in the ovary at the end of this stage
Uterine (Menstrual) Cycle

- Secretory stage
  - Days 15–28
  - Levels of progesterone rise and increase the blood supply to the endometrium
  - Endometrium increases in size and readies for implantation

- Secretory stage (continued)
  - If fertilization does occur
    - Embryo produces a hormone that causes the corpus luteum to continue producing its hormones
  - If fertilization does NOT occur
    - Corpus luteum degenerates as LH blood levels decline

Fluctuation of Gonadotropin Levels

Fluctuation of Ovarian Hormone Levels

Ovarian Cycle
Uterine (Menstrual) Cycle

- Days: 1, 5, 10, 15, 20, 25, 30
- Menstrual phase
- Proliferative phase
- Secretory phase

Hormone Production by the Ovaries

- Estrogens
  - Produced by follicle cells
  - Cause secondary sex characteristics
  - Enlargement of accessory organs
  - Development of breasts
  - Appearance of axillary and pubic hair
  - Increase in fat beneath the skin, particularly in hips and breasts
  - Widening and lightening of the pelvis
  - Onset of menses (menstrual cycle)

- Progesterone
  - Produced by the corpus luteum
  - Production continues until LH diminishes in the blood
  - Does not contribute to the appearance of secondary sex characteristics
  - Other major effects
    - Helps maintain pregnancy
    - Prepare the breasts for milk production

Female Reproductive System Overview

Developmental Stages of Ovarian Follicle
Mammary Glands
- Present in both sexes, but only function in females
- Modified sweat glands
- Function is to produce milk
- Stimulated by sex hormones (mostly estrogens) to increase in size

Anatomy of Mammary Glands
- Areola—central pigmented area
- Nipple—protruding central area of areola
- Lobes—internal structures that radiate around nipple
- Lobules—located within each lobe and contain clusters of alveolar glands
- Alveolar glands—produce milk when a woman is lactating (producing milk)
- Lactiferous ducts—connect alveolar glands to nipple

Female Mammary Glands

Mammography
- X-ray examination that detects breast cancers too small to feel
- Recommended every 2 years for women between 40 and 49 years old and yearly thereafter
Mammograms

Stages of Pregnancy and Development
- Fertilization
- Embryonic development
- Fetal development
- Childbirth

Fertilization
- The oocyte is viable for 12 to 24 hours after ovulation
- Sperm are viable for 24 to 48 hours after ejaculation
- For fertilization to occur, sexual intercourse must occur no more than 2 days before ovulation and no later than 24 hours after
- Sperm cells must make their way to the uterine tube for fertilization to be possible

Mechanisms of Fertilization
- When sperm reach the oocyte, enzymes break down the follicle cells of the corona radiata around the oocyte
- Once a path is cleared, sperm undergo an acrosomal reaction (acrosomal membranes break down and enzymes digest holes in the oocyte membrane)
- Membrane receptors on an oocyte pull in the head of the first sperm cell to make contact
- The membrane of the oocyte does not permit a second sperm head to enter
- The oocyte then undergoes its second meiotic division to form the ovum and a polar body
- Fertilization occurs when the genetic material of a sperm combines with that of an oocyte to form a zygote
The Zygote

- First cell of a new individual
- The result of the fusion of DNA from sperm and egg
- The zygote begins rapid mitotic cell divisions
- The zygote stage is in the uterine tube, moving toward the uterus

Cleavage

- Rapid series of mitotic divisions that begins with the zygote and ends with the blastocyst
- Zygote begins to divide 24 hours after fertilization
- Three to 4 days after ovulation, the preembryo reaches the uterus and floats freely for 2–3 days
- Late blastocyst stage—embryo implants in endometrium (day 7 after ovulation)
Slide 31

Figure 16.15, step 3
Cleavage

- Ovulation
- Uterus
- Endometrium
- Uterine tube
- Zygote (fertilized egg)
- Early cleavage
- 4-cell stage

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Figure 16.15, step 4
Cleavage

- Ovary
- (a) (b)
- (a)
- (b)
- (c)
- Early cleavage
- 4-cell stage
- Morula

Slide 33

Figure 16.15, step 5
Cleavage

- Ovary
- (a) (b) (d)
- (a)
- (b) (c)
- (d)
- Early blastocyst
- Late blastocyst (implanting)

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Figure 16.15, step 6
Cleavage

- Ovary
- (a) (b) (d) (e)
- (a)
- (b) (c)
- (d)
- (e)

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Developmental Stages

- Embryo—developmental stage until ninth week
- Morula—16-cell stage
- Blastocyst—about 100 cells
- Fetus—beginning in ninth week of development
Slide 36

**The Embryo**
- The embryo first undergoes division without growth
- The embryo enters the uterus at the 16-cell state (called a morula) about 3 days after ovulation
- The embryo floats free in the uterus temporarily
- Uterine secretions are used for nourishment

Slide 37

**The Blastocyst (Chorionic Vesicle)**
- Ball-like circle of cells
- Begins at about the 100-cell stage
- Secretes human chorionic gonadotropin (hCG) to induce the corpus luteum to continue producing hormones
- Functional areas of the blastocyst
  - Trophoblast—large fluid-filled sphere
  - Inner cell mass—cluster of cells to one side

Slide 38

**The Blastocyst (Chorionic Vesicle)**
- Primary germ layers are eventually formed
  - Ectoderm—outside layer
  - Mesoderm—middle layer
  - Endoderm—inside layer
- The late blastocyst implants in the wall of the uterus (by day 14)

Slide 39

**Derivatives of Germ Layers**
- Ectoderm
  - Nervous system
  - Epidermis of the skin
- Endoderm
  - Mucosae
  - Glands
- Mesoderm
  - Everything else

Slide 40

**Embryo of Approximately 18 Days**
Development After Implantation

- Chorionic villi (projections of the blastocyst) develop
- Cooperate with cells of the uterus to form the placenta
- Amnion—fluid-filled sac that surrounds the embryo
- Umbilical cord
  - Blood-vessel containing stalk of tissue
  - Attaches the embryo to the placenta

Embryo of Approximately 18 Days

The 7-week Embryo

Functions of the Placenta

- Forms a barrier between mother and embryo (blood is not exchanged)
- Delivers nutrients and oxygen
- Removes waste from embryonic blood
- Becomes an endocrine organ (produces hormones) and takes over for the corpus luteum (by end of second month) by producing
  - Estrogen
  - Progesterone
  - Other hormones that maintain pregnancy

The Fetus (Beginning of the Ninth Week)

- All organ systems are formed by the end of the eighth week
- Activities of the fetus are growth and organ specialization
- This is a stage of tremendous growth and change in appearance
Slide 46

Photographs of a Developing Fetus

Slide 47

Photographs of a Developing Fetus

Slide 48

Development of the Human Fetus

Slide 49

Development of the Human Fetus

Slide 50

Effects of Pregnancy on the Mother

- Pregnancy—period from conception until birth
- Anatomical changes
  - Enlargement of the uterus
  - Accentuated lumbar curvature (lordosis)
  - Relaxation of the pelvic ligaments and pubic symphysis due to production of relaxin
### Slide 51
**Effects of Pregnancy on the Mother**
- **Physiological changes**
  - Gastrointestinal system
    - Morning sickness is common due to elevated progesterone and estrogens
    - Heartburn is common because of organ crowding by the fetus
    - Constipation is caused by declining motility of the digestive tract

### Slide 52
**Effects of Pregnancy on the Mother**
- **Physiological changes (continued)**
  - Urinary system
    - Kidneys have additional burden and produce more urine
    - The uterus compresses the bladder, causing stress incontinence

### Slide 53
**Effects of Pregnancy on the Mother**
- **Physiological changes (continued)**
  - Respiratory system
    - Nasal mucosa becomes congested and swollen
    - Vital capacity and respiratory rate increase
    - Dyspnea (difficult breathing) occurs during later stages of pregnancy

### Slide 54
**Effects of Pregnancy on the Mother**
- **Physiological changes (continued)**
  - Cardiovascular system
    - Blood volume increases by 25–40%
    - Blood pressure and pulse increase
    - Varicose veins are common

### Slide 55
**Childbirth (Parturition)**
- **Labor**—the series of events that expel the infant from the uterus
  - Rhythmic, expulsive contractions
  - Operates by the positive feedback mechanism
  - False labor—Braxton Hicks contractions are weak, irregular uterine contractions
Childbirth (Parturition)

- Initiation of labor
- Estrogen levels rise
- Uterine contractions begin
- The placenta releases prostaglandins
- Oxytocin is released by the pituitary
- Combination of these hormones oxytocin and prostaglandins produces contractions

Initiation of Labor

- Hypothalamus sends efferent impulses to posterior pituitary, where oxytocin is stored
- Posterior pituitary releases oxytocin to blood; oxytocin targets mother's uterine muscle
- Uterus responds by contracting more vigorously
- Afferent impulses to hypothalamus
- Pressoreceptors in cervix of uterus excited
- Baby moves deeper into mother's birth canal
- Positive feedback mechanism continues to cycle until interrupted by birth of baby
Initiation of Labor

Hypothalamus sends efferent impulses to posterior pituitary, where oxytocin is stored.

Afferent impulses to hypothalamus

Pressoreceptors in cervix of uterus excited

Baby moves deeper into mother's birth canal

Positive feedback mechanism continues to cycle until interrupted by birth of baby.

Stages of Labor

- Dilation
  - Cervix becomes dilated
  - Full dilation is 10 cm
  - Uterine contractions begin and increase
  - Cervix softens and effaces (thins)
  - The amnion ruptures ("breaking the water")
  - Longest stage at 6–12 hours
Stages of Labor

• Expulsion
  - Infant passes through the cervix and vagina
  - Can last as long as 2 hours, but typically is 50 minutes in the first birth and 20 minutes in subsequent births
  - Normal delivery is head first (vertex position)
  - Breech presentation is buttocks-first

• Placental stage
  - Delivery of the placenta
  - Usually accomplished within 15 minutes after birth of infant
  - Afterbirth—placenta and attached fetal membranes
  - All placental fragments should be removed to avoid postpartum bleeding

Developmental Aspects of the Reproductive System

• Gender is determined at fertilization
  - Males have XY sex chromosomes
  - Females have XX sex chromosomes
  - Gonads do not begin to form until the eighth week
  - Testosterone determines whether male or female structures will form
Developmental Aspects of the Reproductive System

- Reproductive system organs do not function until puberty
- Puberty usually begins between ages 10 and 15

Developmental Aspects of the Reproductive System

- Males
  - Enlargement of testes and scrotum signals onset of puberty (often around age 13)
- Females
  - Budding breasts signal puberty (often around age 11)
  - Menarche—first menstrual period

Developmental Aspects of the Reproductive System

- Menopause—a whole year has passed without menstruation
  - Ovaries stop functioning as endocrine organs
  - Childbearing ability ends
  - There is no equivalent of menopause in males, but there is a steady decline in testosterone

A Closer Look: Contraception

- Contraception—birth control
  - Birth control pill—most-used contraceptive
  - Relatively constant supply of ovarian hormones from pill is similar to pregnancy
  - Ovarian follicles do not mature, ovulation ceases, menstrual flow is reduced

A Closer Look: Contraception

- Morning-after pill (MAP)
  - Taken within 3 days of unprotected intercourse
  - Disrupts normal hormonal signals to the point that fertilization is prevented
  - Other hormonal birth control devices cause cervical mucus to thicken
  - Minepill (tablet)
  - Norplant (rods placed under the skin)
A Closer Look: Contraception

- **Intrauterine device (IUD)**
  - Plastic or metal device inserted into uterus
  - Prevents implantation of fertilized egg
- **Sterilization**
  - Tubal ligation (females)—cut or cauterize uterine tubes
  - Vasectomy (males)—cut or cauterize the ductus deferens

- **Coitus interruptus**—withdrawal of penis prior to ejaculation
- **Rhythm (fertility awareness)**—avoid intercourse during period of ovulation or fertility
  - Record daily basal temperature (body temperature rises after ovulation)
  - Record changes in pattern of salivary mucus

- **Barrier methods**
  - **Diaphragms**
  - **Cervical caps**
  - **Condoms**
  - **Spermicidal foams**
  - **Gels**
  - **Sponges**

- **Abortion**—termination of pregnancy
- **Miscarriage**—spontaneous abortion is common and frequently occurs before a woman knows she is pregnant
  - RU486 or “abortion pill”—induces miscarriage during first 7 weeks of pregnancy

Flow Chart of Events that Must Occur to Produce a Baby
Some Contraceptive Devices

- IUD
- Progestin implant (Norplant®)
- Intrauterine tissue implant
- Condom

Figure 16.21 (2 of 2)