Anatomy
Female Gonads - Ovaries

One of 3 ligaments holding each ovary in place – ligaments are estrogen sensitive
Ovaries

1.5 in. or 3 cm

1/3 in. or 0.5 cm
Immature Ova

- Maximum number in fetal ovary at 20 weeks post conception – app. 7 million
- At birth – 400,000 – 1 million remain
- Puberty – 50,000 remain
- Typically, 400 mature ova are released at ovulation between puberty and menopause.
Ovary and Hormones

- Ovary contains two sequentially present endocrine glands.
  1. During the preovulatory phase of the cycle, this is the ovarian follicle or more specifically for most of this phase, the Graafian follicle.
  2. During the postovulatory phase of the cycle, this is the corpus luteum.
Divisions of the Monthly Cycle

First Half of Cycle
Day 1 to Ovulation

Menses
Day 1
First Day of Menses

Ovulation
Separates first and second halves of cycle

Day 1
First Day of Menses
Divisions of the Monthly Cycle

Day 1 – First Day of Menses

ovulation
Divisions of the Monthly Cycle

First Half of Cycle

Preovulatory Phase (time)

Follicular Phase (ovary)

Ø Proliferative Phase (uterus)

Menses

Day 1
First Day of Menses

Ovulation
Separates first and second halves of cycle

Day 1
Divisions of the Monthly Cycle

Preovulatory Phase

Length: Variable

(can vary from cycle-to-cycle for 1 woman or differ from woman-to-woman)

Menses

Day 1
First Day of Menses

Ovulation
Separates first and second halves of cycle

Day 1
Divisions of the Monthly Cycle

Day 1
First Day of Menses

Menses

Ovulation
Separates first and second halves of cycle

Second Half of Cycle
Ovulation to Day 1

Day 1
Divisions of the Monthly Cycle

Day 1
First Day of Menses

Menses

Day 1
First Day of Menses

Ovulation
Separates first and second halves of cycle

Second Half of Cycle
Postovulatory Phase (time)
Luteal Phase (ovary)
Secretory Phase (uterus)
Divisions of the Monthly Cycle

Day 1
First Day of Menses

Menses

Ovulation
Separates first and second halves of cycle

Day 1

Postovulatory Phase

Length: 14 ± 2 days
(length relatively constant from month-to-month and from woman-to-woman)
Ovarian Cycle
Preovulatory Phase

Blood Vessels
Maturing Ovarian Follicles
Connective Tissue
Maturing Ovum in Maturing Graafian Follicle
Mature Graafian Follicle
Follicular Fluid
Ovarian Monthly Cycle

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Ovarian Cycle
PreovulATORY Phase
Ovarian/Graafian Follicle

- At start of cycle, about 20 immature ova and their respective follicles begin the maturation process
- Each follicle about 0.25 mm in diameter at that time
Ovarian/Graafian Follicle

- Over the first few days of the monthly cycle, typically all but one follicle/ovum complex die off.
- The remaining follicle, which contains the ovum that will be released at ovulation, is called the **Graafian Follicle**.
Changes in Graafian Follicle during the Preovulatory Phase

1. **Proliferation** of follicular cells – cells increase in size and number
   
a. Follicle size increases to 18-20 mm in diameter

2. Increase in follicular fluid

3. Maturation of the ovum
Ovarian Cycle
Preovulatory Phase

- Blood Vessels
- Maturing Ovarian Follicles
- Connective Tissue
- Maturing Ovum in Maturing Graafian Follicle
- Mature Graafian Follicle
- Follicular Fluid
Ovarian Hormones - Preovulatory Phase

- Hormone-Producing Site - Ovarian Follicle/Graafian Follicle

Hormones Produced:

- Estrogen (Estradiol)
- Androgens
- Inhibin
Estrogens

- Estradiol – most common, active estrogen. Often referred to colloquially as estrogen.
- Estrial – produced mainly during pregnancy
- Estrone – produced mainly after menopause
Ovarian Cycle
Ovulation

- Ruptured Graafian Follicle
- Ovulated Ovum
- Corona Radiata
- Blood Clot
Ovarian Monthly Cycle

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Substances Released at Ovulation

1. follicular fluid
2. the ovum
3. corona radiata
4. sticky cumulus
Substances Released at Ovulation

- follicular fluid
- the ovum
- corona radiata - provided nutrients for ovum from ovulation until the ovum is inside the oviduct
- sticky cumulus
Substances Released at Ovulation

- follicular fluid
- the ovum
- corona radiata
- sticky cumulus - a sticky layer of cells that surrounds the ovum/corona radiata that
  1) holds it at the ovary until it is picked up by the oviduct and
  2) helps with the transport of the ovum into and through the oviduct
Ovarian Monthly Cycle

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From Lousse & Donnez, Fertility & Sterility, 2008
Mittelschmerz

- Middle pain
- Pain at ovulation due to irritation of organs and structures in the pelvic cavity by blood released with the rupture of the ovarian wall at ovulation
- Happens to some degree in about 20% of ovulating women but severe or long-lasting pain occurs in much smaller proportion of population.
Ovarian Cycle
Postovulatory Phase – Corpus Luteum

- Corpus Albicans
- Later Corpus Luteum
- Early Corpus Luteum
Ovarian Monthly Cycle

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Ovarian Cycle
Postovulatory Phase – Corpus Luteum

Corpus Albicans

Later Corpus Luteum

Early Corpus Luteum
Ovarian Hormones - Postovulatory Phase

- Hormone Producing Site: Corpus Luteum

Hormones Produced:

- Progesterone
- Estradiol
- Androgens
- Inhibin
Ovarian Cycle
Postovulatory Phase – Corpus Albicans

- Early Corpus Luteum
- Later Corpus Luteum
- Corpus Albicans
Oviduct (Fallopian Tube)

Diagram showing the Oviduct, Isthmus, Ampulla, and Fimbria.
Ovary with Fimbria of Oviduct
Fimbria

- Cilia (hair-like cells) lining the surface of the fimbria remove the sticky cumulus/ovum unit from the wall of the ovary and move it into the lumen (opening) of the oviduct.

- Once ovum is in the oviduct, nutrition comes from cells lining the oviduct.
Grants are available when money is raised for non-profit organizations or projects.
Oviduct (Fallopian Tube)
Ampulla

- Makes up about ½ the total length of the oviduct
- Thin muscle wall; wider lumen
- Movement by cilia (minor player)
- Movement by segmental peristaltic contractions (major mechanism)
- Move from fimbria to ampulla-isthmus junction in minutes
Ampulla-Isthmus junction

- Ovum held here for 2-2.5 days
- Most common site of fertilization of the ovum
- Typical ovum viable for fertilization for up to 24 hours
Isthmus

- Thicker muscle wall and narrower lumen than ampulla
- Movement again mainly by segmental peristaltic contractions
- Slower movement – takes 0.5-1.5 days to get to uterus once released from ampulla-isthmus junction
Ovum through oviduct (timing summary)

- Ovarian wall through fimbria and ampulla of oviduct to ampulla-isthmus junction - minutes
- Stay at ampulla-isthmus junction - 2-2.5 days
- Creep through isthmus to uterus - 0.5-1.5 days
- Arrives at uterus 3-4 days after ovulation
- If fertilized, will start to implant in the uterine wall 2-3 days after arriving in the uterus (5-7 days after ovulation)
Ectopic Pregnancy

- Any pregnancy in which implantation and growth of the embryo occurs anywhere except the upper 2/3 of the uterus
- Most common – tubal pregnancy – development in oviduct
Uterus
Uterus
Cervix
Cervical Mucus

- Hormone sensitive
- Around ovulation (high estrogen, low progesterone), cervical mucus like raw egg whites – wet and slippery
- Post ovulatory (high estrogen and high progesterone) – cervical mucus is thick and pasty
- Protect uterus from bacterial infection
Fundus
Layers of Uterine Muscle (Fundus)
Divisions of the Monthly Cycle

First Half of Cycle

Preovulatory Phase (time)

Follicular Phase (ovary)

Ø Proliferative Phase (uterus)

Menses

Day 1

First Day of Menses

Ovulation

Separates first and second halves of cycle

Day 1
The Uterine Monthly Cycle

1. Menses
2. Proliferative Phase

Day 1
First Day of Menses

Ovulation
Separates first and second halves of cycle

Day 1
The Uterine Monthly Cycle

1. **Menses** - days of menstrual bleeding

2. **Proliferative Phase**

*Note: Day 1 of the cycle is always the first day of menses.*
Layers of Uterine Muscle (Fundus)
Menstrual Fluid

- Blood - typically only about 2-4 tablespoons. Only clots on exposure to air.
- Glandular secretions from the endometrial cells
- The unfertilized ovum and fragments from endometrial cells.
Source of Menstrual Blood

- Coiled arteries transport blood through endometrium
- As endometrium becomes thinner, coils get tighter
- Eventually the coil is so tight, it breaks and blood is released
Menstrual Fluid

- Blood - typically only about 2-4 tablespoons. Only clots on exposure to air.
- Glandular secretions from the endometrial cells
- The unfertilized ovum and fragments from endometrial cells.
Dysmenorrhea

- Menstrual CRAMPS
- Caused by very high levels of prostaglandins in the uterus
- Can be treated by drugs that block prostaglandin synthesis such as aspirin, ibuprofen, acetaminophen, etc.
- Prostaglandins are also very high during labor
  - Used with Pitocin to stimulate labor
The Uterine Monthly Cycle

1. Menses

2. Proliferative Phase - endometrial cells increase in size and number

*Note: The proliferative phase runs from the end of menses to ovulation NOT from Day 1 to ovulation.
The Uterine Monthly Cycle

The secretory phase runs from ovulation until Day 1 of the next cycle.

Secretory Phase - endometrial cells fill with fats and glycogen

Day 1
First Day of Menses

Ovulation
Separates first and second halves of cycle

Day 1
Layers of Uterine Muscle (Fundus)
Endometriosis

- Growth of endometrial tissue outside the uterus
- Undergoes all the cyclic changes that uterine endometrial tissue experiences including sloughing off and bleeding (menses)
- Severe pain at the same time as menses
- Scar tissue can build up at the site of the endometrial tissue which can result in decreased fertility
Uterus
Vagina

- fallopian tube
- ovaries
- sigmoid colon
- uterus
- fornix
- cervix
- rectum
- bladder
- pubic bone
- g-spot
- clitoris
- urethra
- vagina
- anus
Vagina

- Tube that passes at a 45° angle from the vaginal opening to the uterus
- Very distensible
- Anterior and posterior walls in close apposition
Vaginal Fornices

- Widened areas at the top of the vagina near the cervix
  1. Pooling place for semen/sperm to optimize chance of fertilization
  2. Shock absorbers to reduce pressure on cervix during vaginal penetration
Vaginal Lining

- Lining is estrogen sensitive
  - High estrogen = thicker lining and more rapid cell turnover
  - Low estrogen = thinner lining and slower cell turnover
Layers of Uterine Muscle
Vaginal Secretions

- Secretions more acidic during reproductive years
  - Acidity reduced by cervical mucus at midcycle

- Vaginal lubrication during sexual excitement
  - Due to veins deep in the vaginal lining being engorged with blood forcing fluid from between cells into the lumen of the vagina
  - Lubrication estrogen sensitive – increase with higher estrogen
Grafenberg Spot (G Spot)
G Spot

- Small sensitive spot on front wall of vagina approximately 2 inches from vaginal opening.
- Stimulation may result in ejaculation of fluid through the urethral opening.
Vulva - Visible External Genitalia

Anterior Border: Mons pubis/mons veneris

Posterior border: Perineum (may be cut during childbirth is a procedure called episiotomy)
Labia Majora

Bulbs of the Vestibule
1. specialized erectile tissue inside the labia majora
2. engorges with blood during sexual excitement resulting in an increase in size of the labia majora
Labia Minora

Labia minora meet at the front to form the prepuce or hood of the clitoris.
Vestibule

Vestibule: area of the vulva covered by the labia minora
1. Vaginal opening
2. Hymen
3. Glands of Bartholin
4. Urethral opening
5. Clitoris
Hymen

Slide from: Hock, R. R. Human Sexuality. 2007

- Annular hymen
- Septate hymen
- Cribriform hymen
- Parous (intact) hymen
Vestibule

Vestibule: area of the vulva covered by the labia minora
1. Vaginal opening
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Glands of Bartholin
Vestibule

Vestibule: area of the vulva covered by the labia minora
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Slide from: Hock, R. R.
Human Sexuality. 2007
Clitoris

- Total structure first described by Helen O’Connell in 1998
- Glans or tip very sensitive to touch
- Shaft contains two corpora cavernosa (erectile tissue)
- Crura or legs extend wishbone shaped back along the sides of the urethra and the vagina
Clitoris

Helen O’Connell - 1998

(a) The Clitoris: Unaroused
Clitoris

Slide from: Hock, R. R. Human Sexuality. 2007

Helen O’Connell - 1998

(b) The Clitoris: Aroused
Female Genital Mutilation/Cutting
(Female Circumcision)
Female Genital Mutilation/Cutting in US

![Map showing the number of women and girls who have undergone or are at risk of FGM/C in the US. The map is color-coded as follows: 25,000 or more; 10,000 - 24,999; 5,000 - 9,999; less than 5,000.]
Breast

Areola (smooth muscle)

Montgomery glands:
1. appear as bumps on areola
2. more visible during post-ovulatory phase – most visible during pregnancy and breastfeeding
2. produce lubricating and antibacterial substance during breastfeeding
Mammary Glands

- Rib
- Muscle
- Alveolar cells
- Fatty Tissue
- Connective Tissue
- Lactiferous Duct
- Nipple
- Duct Opening
Mammary Glands

- 15-25 lobes or ducts extend out from the nipple (mostly lateral) (same regardless of breast size)
- Ducts have slightly widened portions near the nipple
- Lobes or ducts end at the alveoli – the actual milk producing glands
  - Very few alveoli except during pregnancy and breast feeding