LH surge stimulates formation of corpus luteum.
- Corpus luteum produces estrogen and progesterone to maintain uterine lining.
- Estrogen and progesterone feedback inhibits GnRH and gonadotropes.
- See Ovary lecture for photos of corpus luteum.
- If there is no pregnancy, corpus luteum dies and estrogen and progesterone levels drop.
Normal Basal body temperature: can be used to detect ovulation

- BB temperature low during follicular phase.
- Drops just before ovulation
- Rises (under influence of progesterone during luteal phase)
- Drops at menstruation
Abnormal Basal body temperature:

- Long follicular phase
- Short luteal phase (days 22-30).
- May have a “luteal phase defect”
- What would that do to uterine endometrium?
Note the changing thickness of the wall (inside diameter) and mucosa.
Wall of oviduct:

- **Outer**: serosa (squamous mesothelium + connective tissue)
- **Middle**: Outer longitudinal and inner circular smooth muscle
- **Mucosa**
  - Lamina propria (connective tissue)
  - Epithelium: thrown into folds; simple columnar, ciliated
Oviduct

Serosa

muscular

lumen

mucosa
Oviduct mucosa

- Lamina propria
- Muscular
- Lumen
- Epithelia
Oviduct mucosa
Oviduct mucosa: two types of cells

- **Peg cells are secretory**
  - Nourish oocyte
  - Sperm capacitation (not needed in *in vitro* fertilization, however)
  - Inhibits growth of microorganisms (protective)
  - Fluid aids in transport

- **Ciliated cells aid in transport**
  - Beat towards the uterus
  - Move fluid and oocyte or embryo towards the uterus
Two types of epithelial cells in oviduct mucosa

- Ciliated cells
- Peg cells
- Lamina propria
Another view of mucosal cells in oviduct. Identify each type.
Figure 4. Diagram of hysterosalpingogram, and actual x-ray (see inset).

No Flow Suggesting Blockage

Spillage
Uterus

- Muscular, pear-shaped organ
  - Body (where oviduct attaches)
  - Fundus (middle region)
  - Cervix (joins vagina)

- Layers:
  - Adventitia (anterior portion) or serosa (posterior portion)
  - Muscular: 3 ill defined layers—inner and outer longitudinal and middle circular; Myometrium
  - Mucosa: simple columnar; tubuloalveolar glands (variable with cycle stage): Endometrium
Layers of endometrium

**Functionalis**

- Supplied by coiled arteries
- Sloughed during menstrual phase

**Basalis**

- Supplied by straight arteries
- Gives rise to new functionalis each cycle
Phases of the endometrium

- **Menstrual:**
  - Days 1-4
  - Endometrium sloughed
  - Corresponds to follicular phase of ovarian cycle

- **Proliferative:**
  - Days 5-14; most variable period
  - Functionalis restored
  - Corresponds to follicular phase of ovarian cycle

- **Secretory:**
  - Days 15-28 (or last 14-16 days of cycle)
  - Glands develop to nourish embryo
  - Corresponds to luteal phase of ovarian cycle
Menstrual phase

- Coiled arteries constrict, reduce oxygen supply to endometrium (functionalis).
- Glands shut down.
- Leukocytes invade
- Arteries rupture and functionalis is sloughed.
- By days 4-5, basalis has begun to proliferate stroma and glands.
Menstrual phase

Glands in basalis region will give rise to new functionalis

Stroma filled with blood and debris

Glands in basalis region will give rise to new functionalis
Proliferative phase

- Glands and stroma are restored by proliferation
- Glands are straight tubules at first
- Many mitotic figures seen
- Stroma is light (not as many cells)
- As it progresses, droplets of glycogen can be seen in glandular cells.
Proliferative phase

- Glands
- Stroma

Mitotic figures (M)
Secretory phase

- Dependent on life of corpus luteum (CL) which is limited by the fact that pituitary gonadotropins are suppressed.
  - Feedback to pituitary is signaled by progesterone and estrogen
  - CL will undergo programmed cell death without a supply of gonadotropins
- CL must stimulate the uterine endometrium to receive an embryo and set up conditions for implantation.
  - Progesterone and estrogen from CL are important for proliferation and development of endometrial secretions.
- Glands become more coiled
- Coiled arteries grow and fully support the functionalis
- Stroma becomes more dense
Secretory phase

Day 16: Characteristic placement of Glycogen droplet under Nucleus (basal).
Important function tests: Proliferative

Cyclin E moves cells from G₁ to S phase of cell cycle; Inhibited by p27

During proliferative phase, cyclin E is high. P27 not high until Secretory phase
Normal endometrial function tests

Cyclin E labeling (brown) in endometrial gland, mid proliferative phase

p27 labeling in nucleus of early secretory (luteal) phase; 16 day)
Tests indicate proliferation is prolonged and differentiation is delayed and short. Endometrium will not support an embryo.
Effects of stress!!

Abnormal EFT During Stressful Life Event, Resolution of Stress with Subsequent Normal EFT

- AC is a 28 yo G2P2 with a history of failed fresh IVF x2 who was very stressed at work during her first cycle. She ultimately quit her job during this cycle and was distraught over her job prospects.
- D15 natural cycle biopsy was not performed due to difficulty getting the patient’s schedule to coordinate with the office.
- D24 biopsy showed significant glandular-stromal dyssynchrony, markedly elevated cyclin E, normal p27.
- Diagnosis: glandular developmental arrest (GDA).
- Followup: repeat EFT two months later.

Abnormal day 24 cyclin E
Abnormal EFT During Stressful Life Event, Resolution of Stress with Subsequent Normal EFT (con’t)

- Over the next two months the patient rested at home, gained 5 lbs (BMI now 19.9), found a new job and was significantly more relaxed and happy. Second EFT was done two months after the first.
- Repeat natural cycle D15 biopsy showed normal dating, normal cyclin E and p27
- Repeat D24 biopsy showed normal dating and no glandular-stromal dyssynchrony, normal cyclin E and p27
- Diagnosis: normal EFT, endometrium is fertile
- Followup: currently undergoing IVF
Cervix

- Connects uterus with vagina; projects into vagina
- Epithelium simple columnar + branched glands
- Epithelium becomes stratified squamous
- Produces serous and mucous secretions
  - Friendly to sperm at midcycle (watery, nutritive)
  - Unfriendly to sperm at other times in cycle (thick, viscous)
  - Thicker mucus protects against bacterial infections
  - Mucus plug formed during pregnancy
- Quality of mucus may be a factor in infertility
Cervix—vaginal transition

Vagina

cervix
Cervical Dysplasia
Cervical carcinoma: PAP smear
Vagina

- Wall: mucosa, muscularis, adventitia
- Muscular layer is smooth, except for sphincter at opening (skeletal)
- Mucosa: stratified squamous epithelium (non-keratinizing).
  - No muscularis mucosa
  - No glands in lamina propria; well vascularized
  - Numerous leukocytes
- Mucosa cells are light staining because of the presence of glycogen
  - Converted to lactic acid
  - Acidifies vagina to pH 3
  - Protects against bacterial infections
- Lubrication: cervical glands; fluid exudate from lamina propria, glands in vestibule (external genitalia).
Vaginal epithelium: non-keratinizing; light staining.
External genitalia

- Labia majora and minora: folds of skin with adipose ct inside. Inside folds is the “vestibule”
- Glands to lubricate area
  - Bartholin
  - Vestibular glands
- Clitoris: between folds of the labia minora (anteriorly); projects just under pubic bone
  - Erectile tissue
  - Pacinian and Meissner’s corpuscles: Sensitive to touch, pressure during sexual arousal
  - Can be enlarged with abnormal androgen stimulation (“ambiguous genitalia”). Sex of baby may be difficult to determine