First Week of Development: Ovulation to Implantation

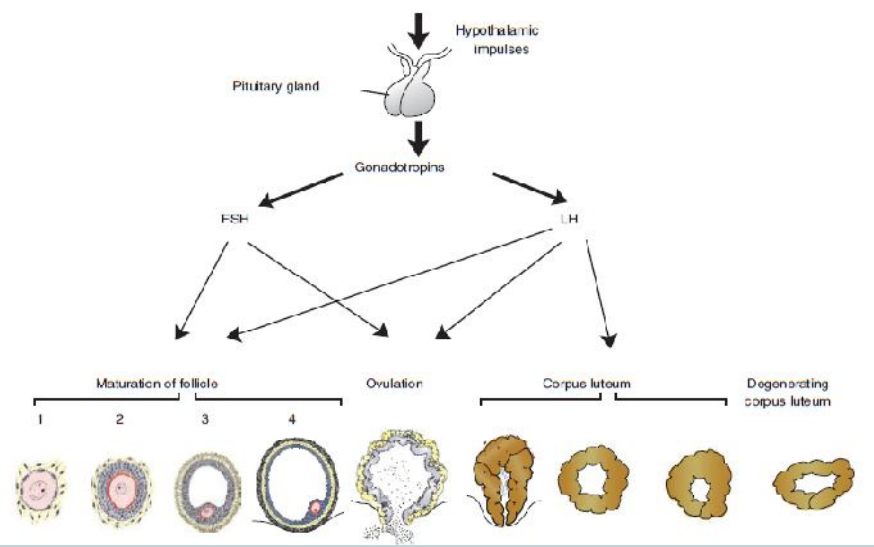
First week of development: ovulation to implantation

- At puberty
- Sexual cycles
- Hypothalamus (GnRH)
- Adenohypophysis (gonadotropins)

LH & FSH

Folicle growth & atresia

GDF-9 (TGF-β)

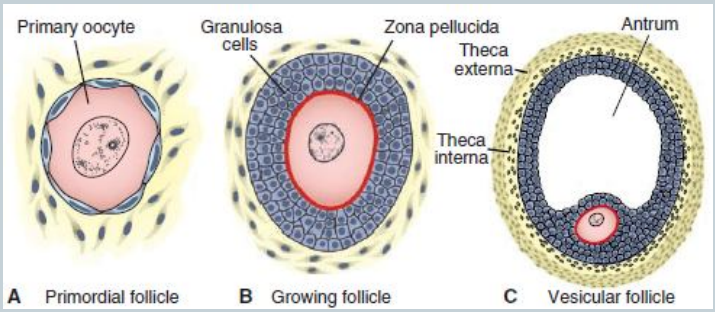


Theca & granulosa cells secret estrogens:

- Uterus enters to follicular or proliferative phase
- Thinning the cervical mucosa
- Pituitary gland stimulation foe LH secretion

LH surge in mid cycle:

- MPF increase, meiosis I completion & meiosis II initiation
- Progestron production by follicular cells (luteinization)
- Follicle rupture & ovulation



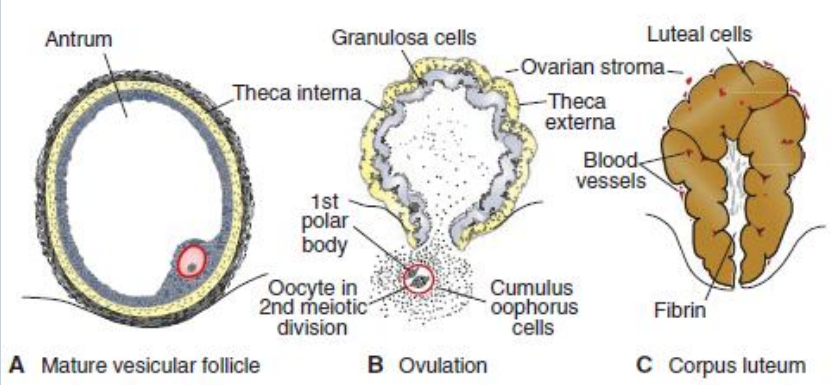
ovulation

- **FSH & LH**
- Follicle growth: 25 mm

- LH surge
- Meioeie I
- Meiosis II
- 3 hours befor ovulation
- Stigma

- LH surge
- Collagenase
- Prostaglandins
- Oocyte-crona radiata complex

- Corpus luteum
- Progestrone production
- Progestational or secretory stage
- Preparation for implantation of the embryo

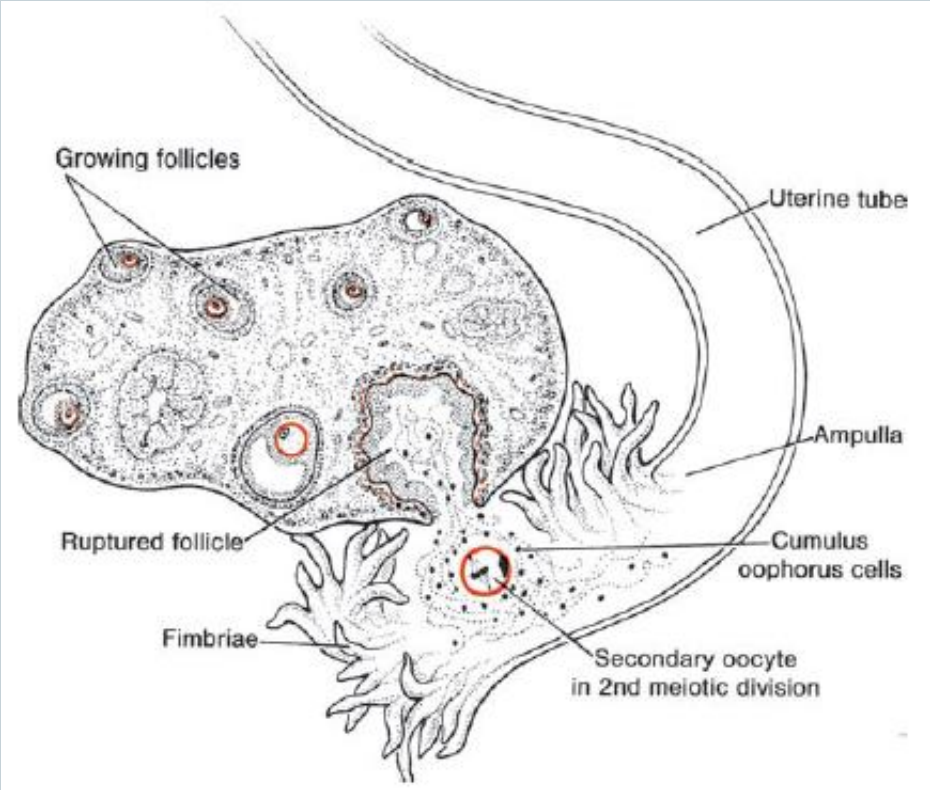


Oocyte transfer

- Uterine fimbriae & Tube rhythmic contract
- cumulus cells withdraw cytoplasmic processes from the zona pellucida
- fertilized oocyte reaches the uterine lumen in 3 to 4 days.

regulated by:

- endocrine status during and after ovulation.



Corpus albicans

No fertilization

- maximum size of corpus luteum 9 days after ovulation
- the co
- the **co**
- **prog**
- menst

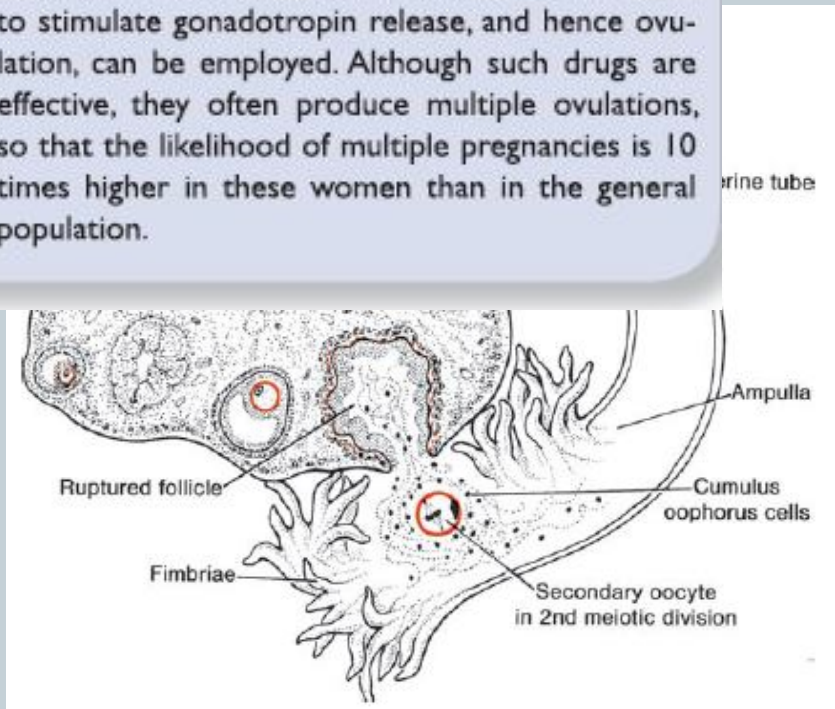
Fertiliza

- Preve
- **hCG**
- **corpus luteum of pregnancy**
- **end of the third** month ½ -1/3 of the size of the ovary
- Luteal cells secrete progesterone until end of the 4th month
- then regress (placental progesterone)
- corpus luteum Removal before 4th month leads to abortion

Clinical Correlates

Ovulation

During ovulation, some women feel a slight pain, called **mittelschmerz** (German for "middle pain") because it normally occurs near the middle of the menstrual cycle. Ovulation is also generally accompanied by a rise in **basal temperature**, which can be monitored to aid couples in becoming pregnant or preventing pregnancy. Some women fail to ovulate because of a low concentration of gonadotropins. In these cases, administration of an agent to stimulate gonadotropin release, and hence ovulation, can be employed. Although such drugs are effective, they often produce multiple ovulations, so that the likelihood of multiple pregnancies is 10 times higher in these women than in the general population.



Clinical Correlates

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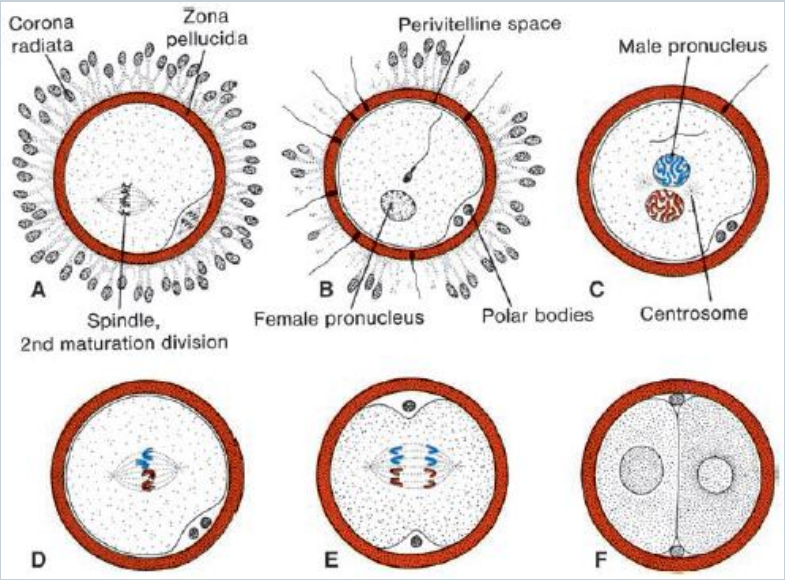
Fertilization

- **Ampullary region of the uterine tube**

Sperm capability

(1) **Capacitation** (female reproductive tract, 7 hours) Removal of a glycoprotein coat and seminal plasma proteins from plasma membrane

(2) **Acrosome reaction (**induced by zona protein, release of enzymes,including acrosin- and trypsin-like substances)



Phases of Fertilization

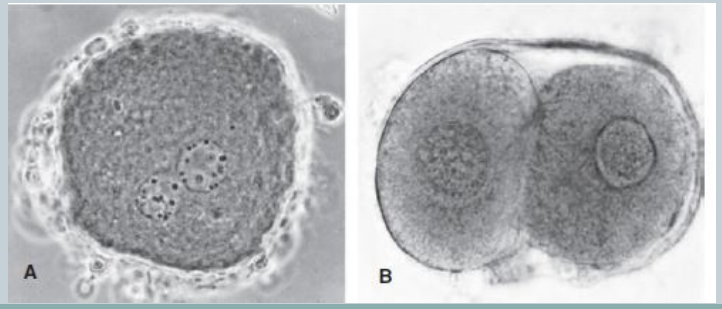
Phase 1, penetration of the corona radiata
Phase 2, penetration of the zona pellucida
Phase 3, fusion of the oocyte and sperm cell membranes

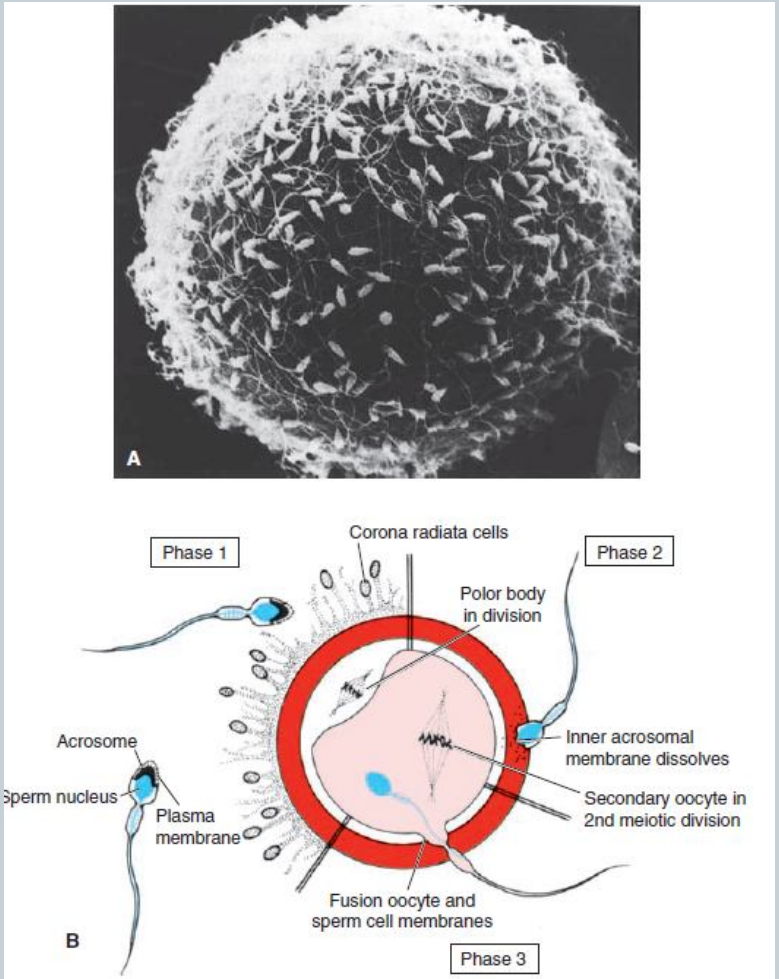
Sperm interance to oocyte:

1. Cortical & zona reaction
2. Resumption of second meiosis division
3. Metabolic activation of the egg

Fertilization results in:

1. Diploid number of chromosomes Restoration
2. Sex determination
3. Cleavage initiation

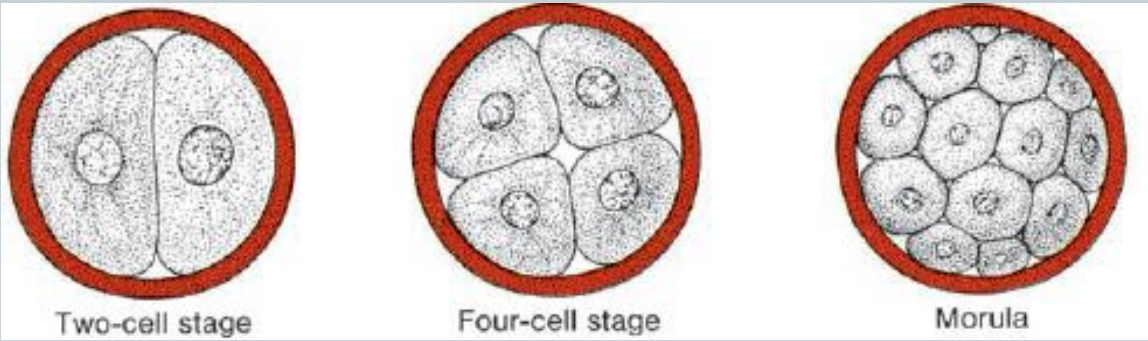


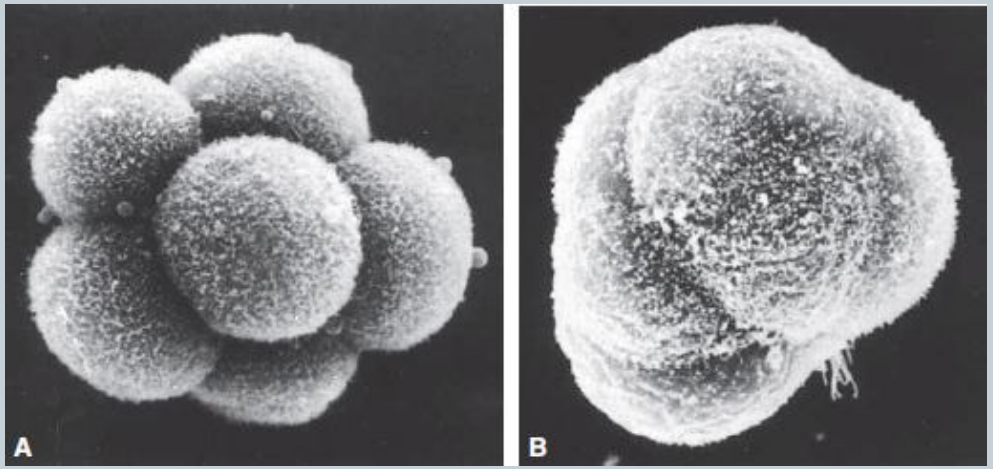


Cleavage

- Zygote
- 2 cells embryo
- 4 cells embryo
- 8 cells embryo
- 16 cells embryo (morula)

- Compaction





Blastocyst formation

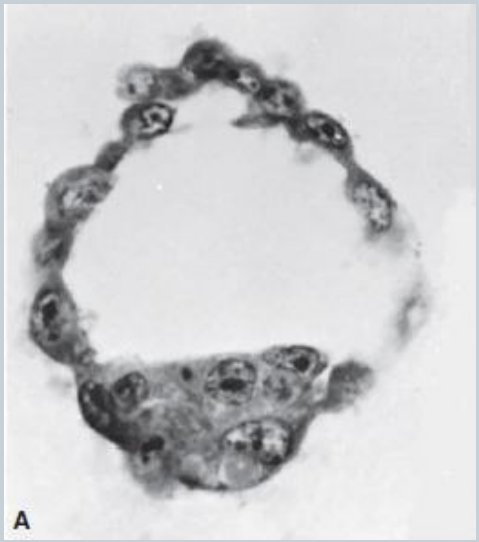
- Uterus enterance
- Fluid penetration to intercellular space
- Blastocele

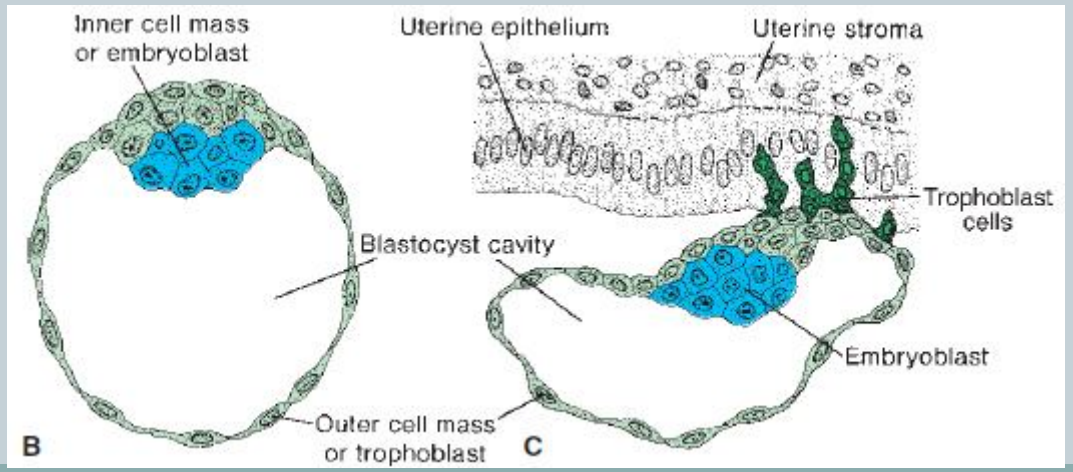
Blastocyst

- Inner cell mass
- Outer cell mass

Embryo (L-selectin, integrins)

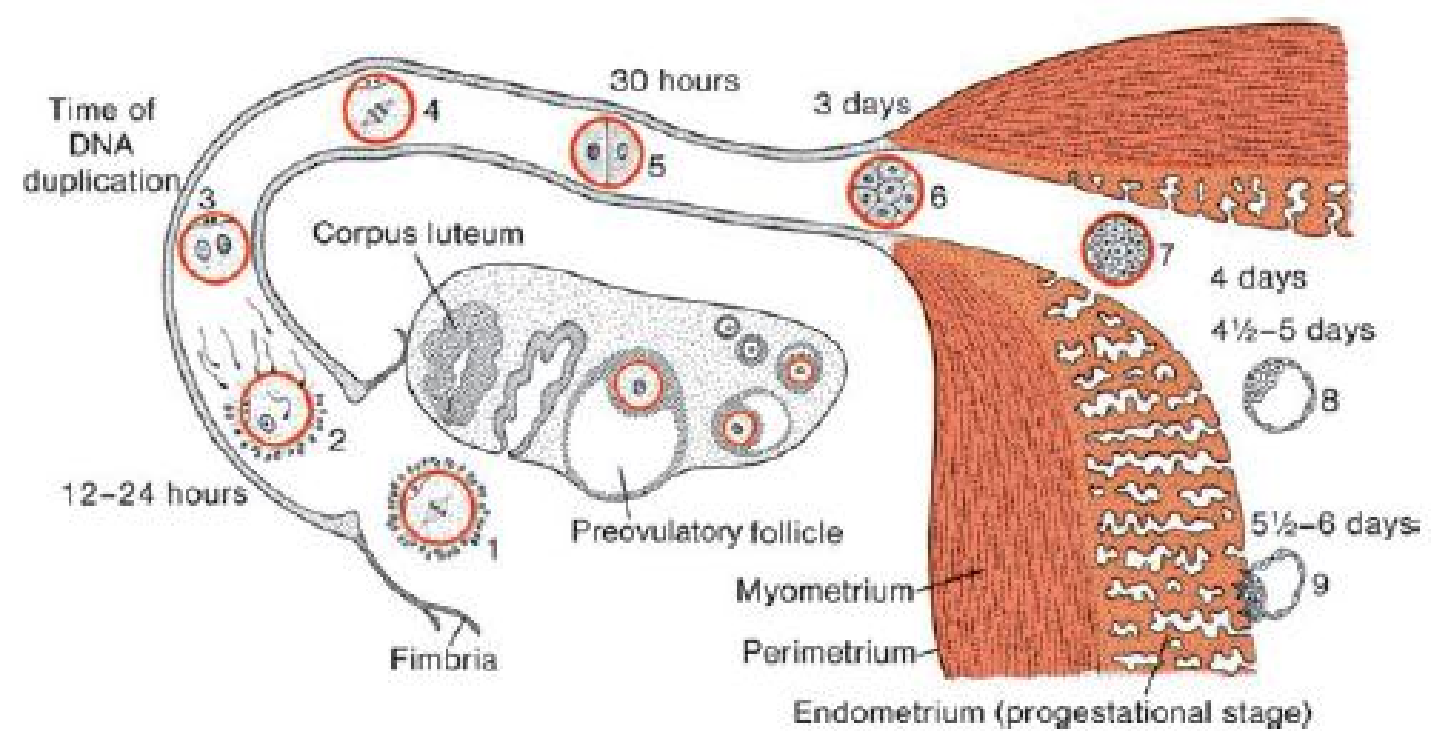
Uterus (carbohydrate receptor, laminin & fibronectin)





Uterus layers

1. Endometrium
2. Myometrium
3. perimetrium



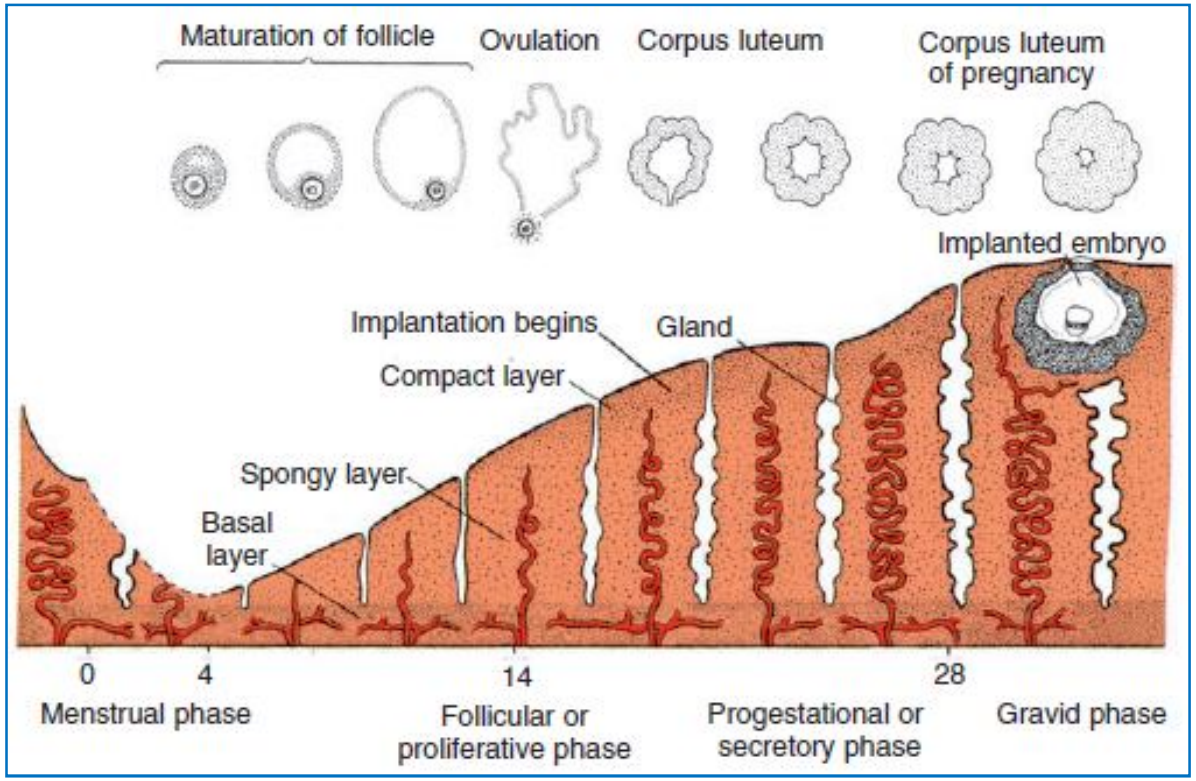
Menstrual cycle

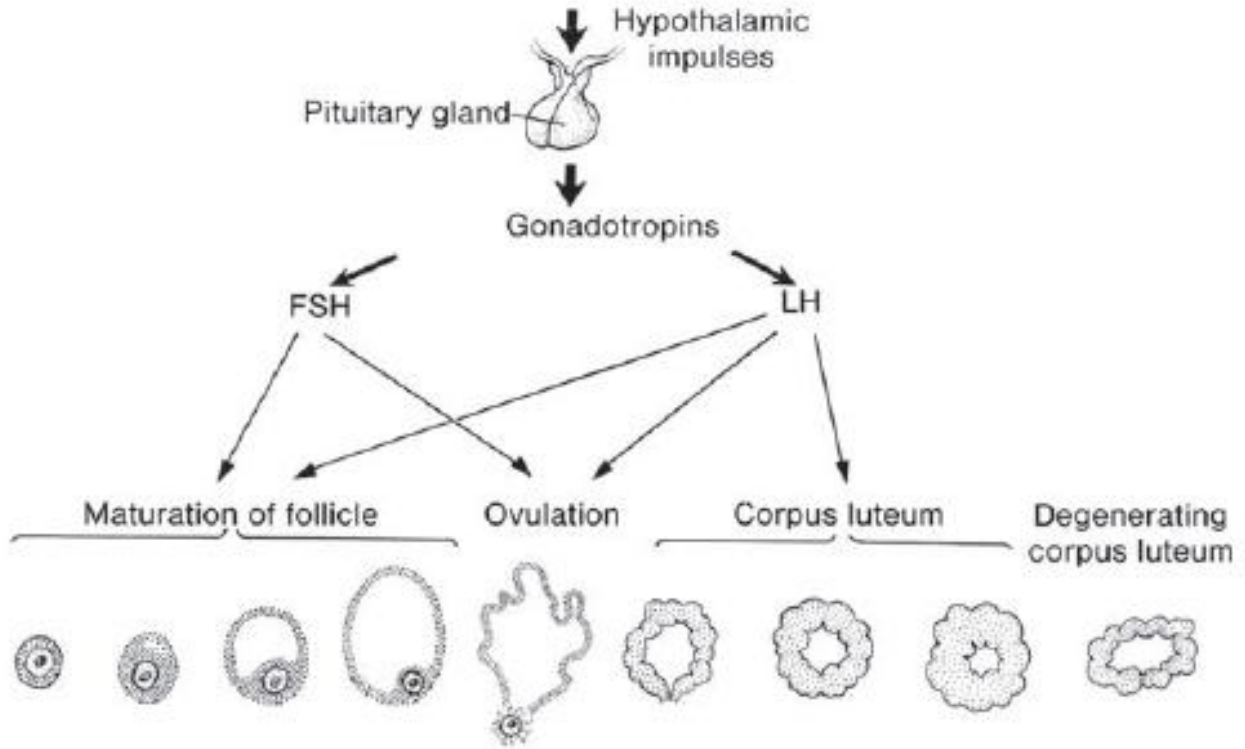
1. **Follicular or proliferative phase**
2. **Secretory or progestational phase**
3. **Menstrual phase**

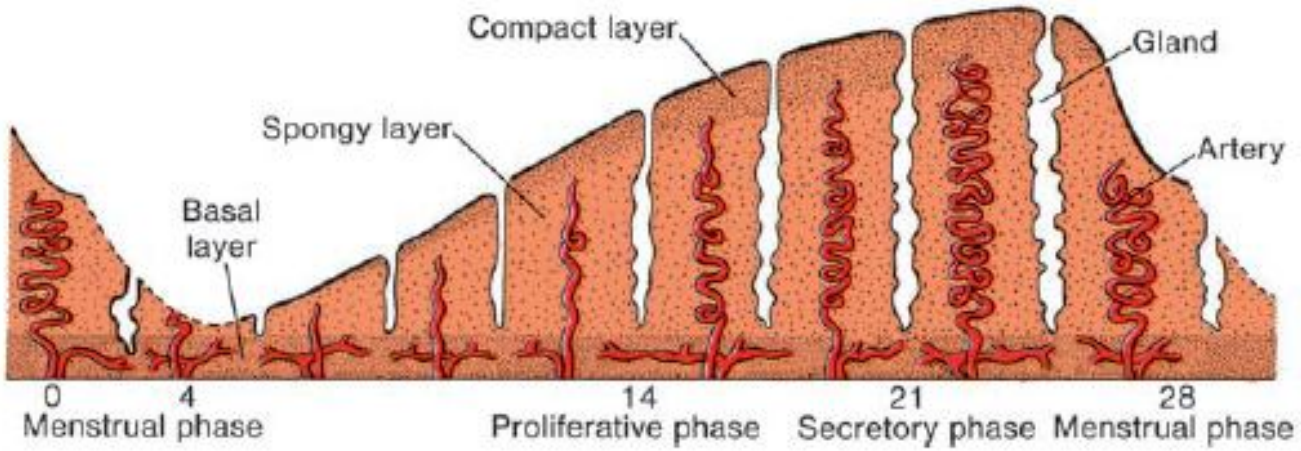
- implantation

Endometrium

- Compact layer
- Spongy layer
- Basal layer




Hypothalamic impulses
Pituitary gland
Gonadotropins
FSH
LH
Maturation of follicle
Ovulation
Corpus luteum
Degenerating corpus luteum


Compact layer
Gland
Spongy layer
Artery
Basal layer
0
4
14
21
28
Menstrual phase
Proliferative phase
Secretory phase
Menstrual phase

Contraceptive Methods

- Barrier methods
- Hormonal methods
- intrauterine device (IUD)
- Emergency contraceptive pills (ECPs)
- Sterilization

Infertility

- 15-30%
- Male factor
- Female factor

- ART
- In vitro fertilization (IVF)
- Intracytoplasmic sperm injection (ICSI)

Clinical Correlates

Embryonic Stem Cells

Embryonic stem cells (ES cells) are derived from the inner cell mass of the embryo. Because these cells are **pluripotent** and can form virtually any cell or tissue type, they have the potential for curing a variety of diseases, including diabetes, Alzheimer's and Parkinson's diseases, anemias, spinal cord injuries, and many others. Using animal model research with stem cells has been encouraging. For example, mouse ES cells in culture have been induced to form insulin-secreting cells, muscle and nerve stem cells, and glial cells. In whole animals, ES cells have been used to alleviate the symptoms of Parkinson's disease and to improve motor ability in rats with spinal cord injuries.

ES cells may be obtained from embryos after **IVF**, a process called **reproductive cloning**. This approach has the disadvantage that the cells may cause immune rejection, because they would not be genetically identical to their hosts. The cells could be modified to circumvent this problem, however. Another issue with this approach is based on ethical considerations, as the cells are derived from viable embryos.

As the field of stem cell research progresses, scientific advances will provide more genetically compatible cells, and the approaches will be less controversial. Most recently, techniques have been devised to take nuclei from adult cells (e.g., skin) and introduce them into enucleated oocytes. This approach is called **therapeutic cloning** or **somatic nuclear transfer**. Oocytes are stimulated to differentiate into blastocysts, and ES cells are harvested. Because the cells are derived from the host, they are compatible genetically, and because fertilization is not involved, the technique is less controversial.

Adult Stem Cells

Adult tissues contain stem cells that may also prove valuable in treating diseases. These cells are restricted in their ability to form different cell types and, therefore, are **multipotent**, not pluripotent, although scientists are finding methods to circumvent this disadvantage. Adult stem cells isolated from rat brains have been used to cure Parkinson's disease in rats, suggesting that the approach has promise. Disadvantages of the approach include the slow rates of cell division characteristic of these cells and their scarcity, which makes them difficult to isolate in sufficient numbers for experiments.

Abnormal Zygotes

The exact number of **abnormal zygotes** formed is unknown because they are usually lost within 2 to 3 weeks of fertilization, before the woman realizes she is pregnant, and therefore are not detected. Estimates are that as many as **50% of pregnancies end in spontaneous abortion** and that half of these losses are a result of chromosomal abnormalities. These abortions are a natural means of screening embryos for defects, reducing the incidence of congenital malformations. Without this phenomenon, approximately 12% instead of 2% to 3% of infants would have birth defects.

With the use of a combination of IVF and **polymerase chain reaction**, molecular screening of embryos for genetic defects is being conducted. Single blastomeres from early-stage embryos can be removed, and their DNA can be amplified for analysis. As the Human Genome Project provides more sequencing information, and as specific genes are linked to various syndromes, such procedures will become more commonplace.