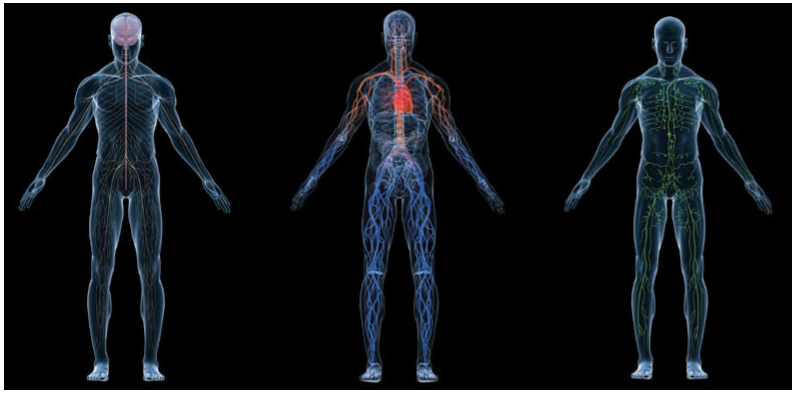


PREGNANCY AND LACTATION

EBAA M ALZAYADNEH

CHAPTER 83 GUYTON

PHYSIOLOGY DEPARTMENT

Lecture I

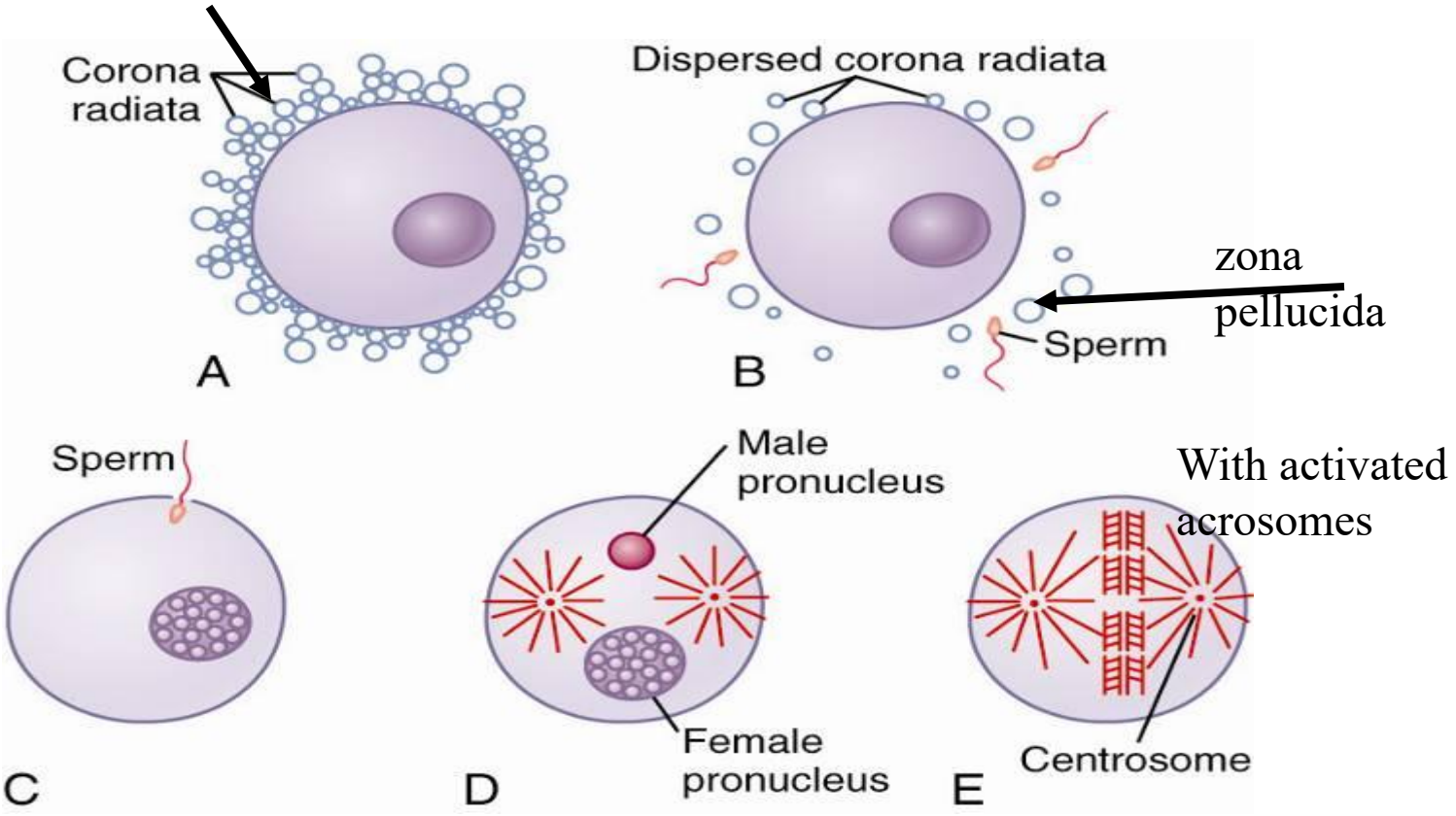
OBJECTIVES

By the end of the 2 lectures, you should be able to:

- Describe fertilization
- Recognize the development and the function of the placenta
- Recognize the placenta as an endocrine organ
- Describe the physiological functions of placental hormones
- Explain the mother's physiological response to pregnancy
- Describe labor and its stimulation
- Understand hormonal mechanisms of lactation

- Sperm penetrates *corona radiata* and *zona pellucida* (hyaluronidase)
- Oocyte divides to form **mature ovum**
  - (female pronucleus 23 unpaired chr)
- Head of sperm swells
  - (male pronucleus 23 unpaired chr)
- release of cortical granules preventing
  - further sperm penetration
  - Both pairs Align
- Fertilized ovum (zygote) contains 23 paired

Granulosa cells



Fertilization: End second meiosis in ovum

Fertilization of the ovum. **A**, The mature ovum sur rounded by the corona radiata. **B**, Dispersal of the corona radiata.
C, Entry of the sperm. **D**, Formation of the male and female pronu
clei. **E**, Reorganization of a full complement of

Figure 82-1 Fertilization of the ovum.

After ejaculation, sperms reach ***ampulla*** of fallopian tube within 30-60 min (PG and OT actions)

Ampulla of oviduct-opt. site of fert.

Location	Time of appearance (min after ejaculation)	Percent of ejaculated sperm*
Fertilization site (upper third of oviduct)	30–60	0.001
Uterus	10–20	0.1
Cervical canal	1–3	3

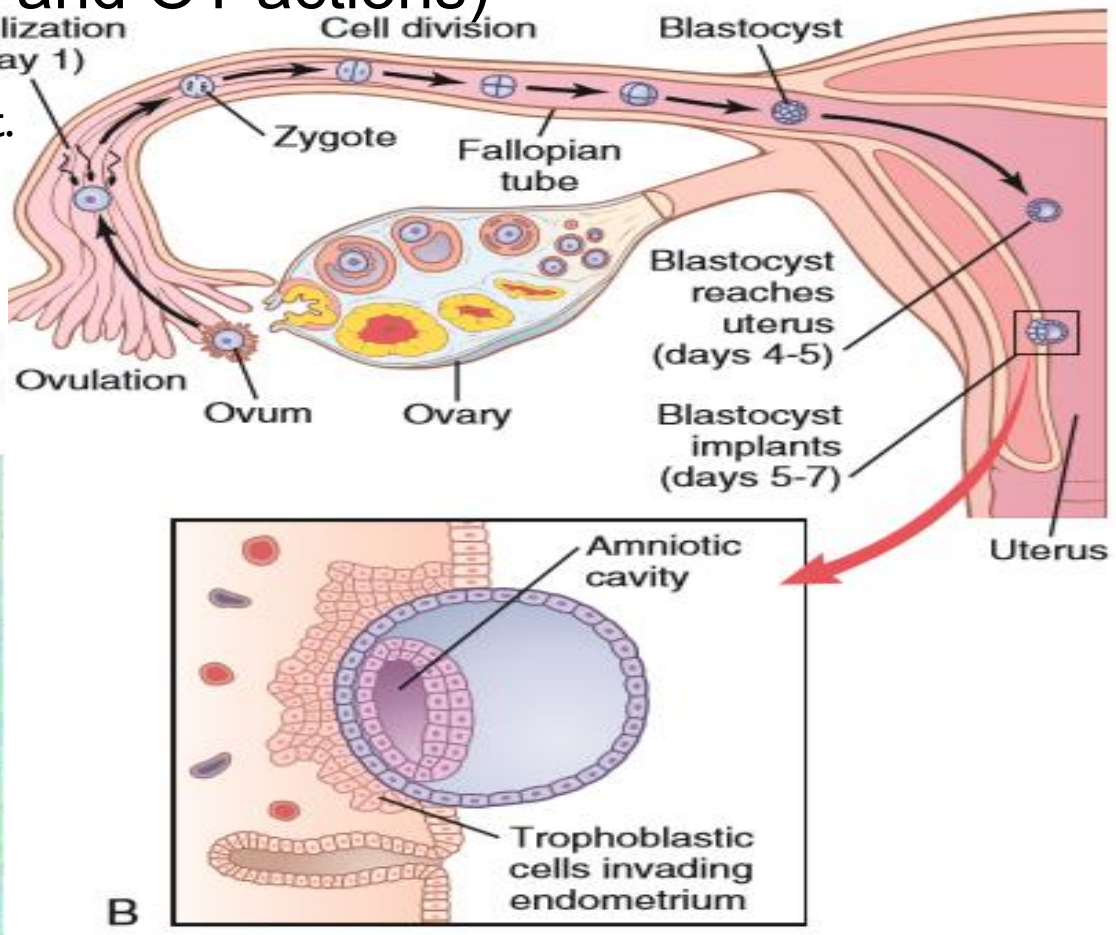


Figure 83-2. A, Ovulation, fertilization of the ovum in the fallopian

Figure Ovulation, fertilization of the ovum in the fallopian tube, development of the blastocyst, and implantation in the endometrium.

Ova can enter the other side

GENDER OF THE BABY

- Y chromosome VS X Chromosome of (sperm or Ova?)

TRANSPORT OF FERTILIZED OVUM

- 3-5 days after fertilization, the zygote reaches uterine cavity
- **Transport:** fluid current + action of cilia + weak contractions of the fallopian tube
- Isthmus (last 2cm) contracts (first 3 days) then relaxes under effect of progesterone
- Delayed transport allows cell division
- Blastocyst (100 cells) enters the uterus
- Nutrition by uterine milk

IMPLANTATION

- Blastocyst remain in uterine cavity 1-3 days b4 implant (conceptus)
- It occurs 5th to 7th day of ovul
- Decidua : endomet cells swell under progest (nutrients) up to 8 weeks
- Trophoblastic cells-cords (proliferation) from blastocyst
- Blood capillaries grow in the cords
- 21 days after fertilization, blood starts to be pumped by fetal heart into the capillaries
- Maternal blood sinuses develop around the trophoblastic cords
- More and more trophoblast projections develop (placental villi)
- Placenta supply: begins 16th day

Organization of the mature placenta and intervillus space.

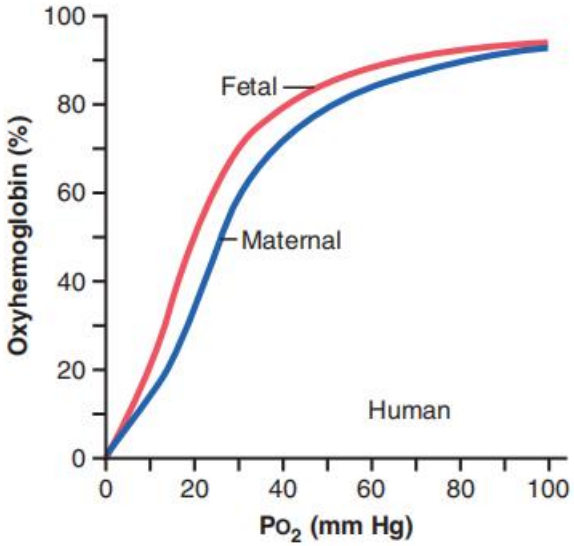
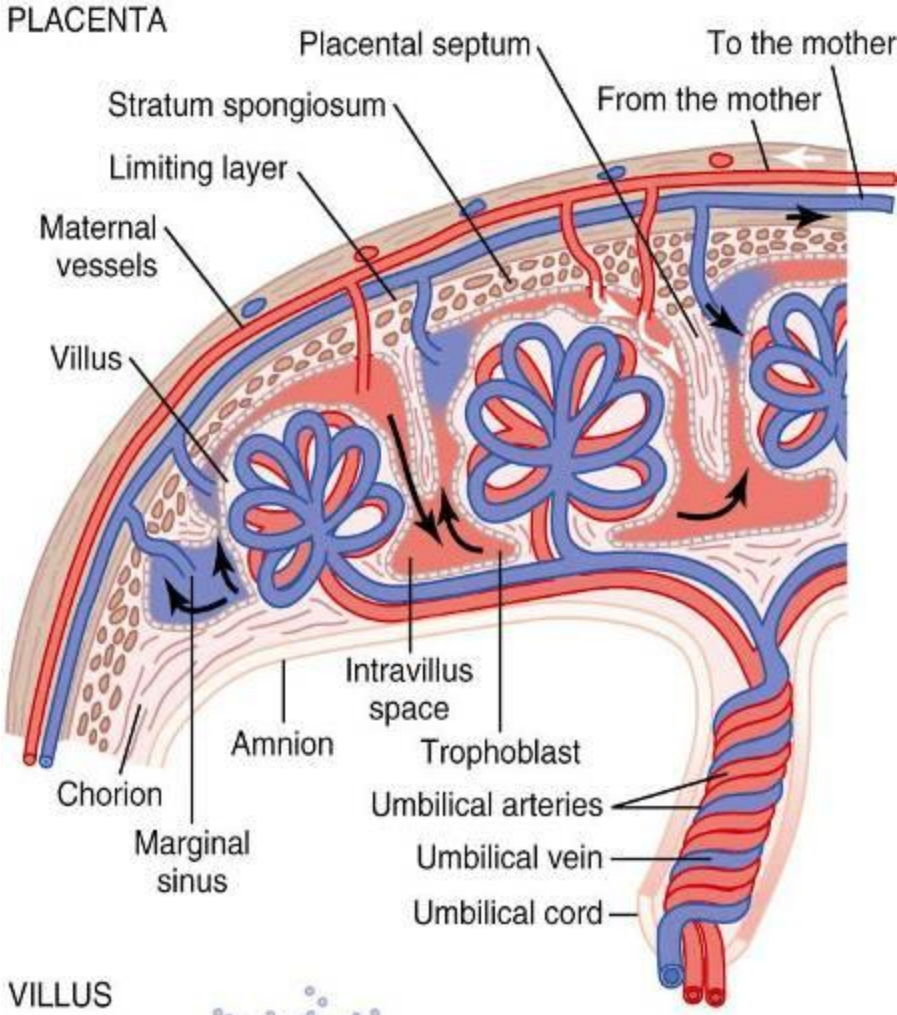


Figure 83-6. Oxygen-hemoglobin dissociation curves for maternal and fetal blood, showing that fetal blood can carry a greater quantity of oxygen than can maternal blood for a given blood Po_2. *(Data from Metcalfe J, Moll W, Bartels H: Gas exchange across the placenta. Fed Proc 23:775, 1964.)*



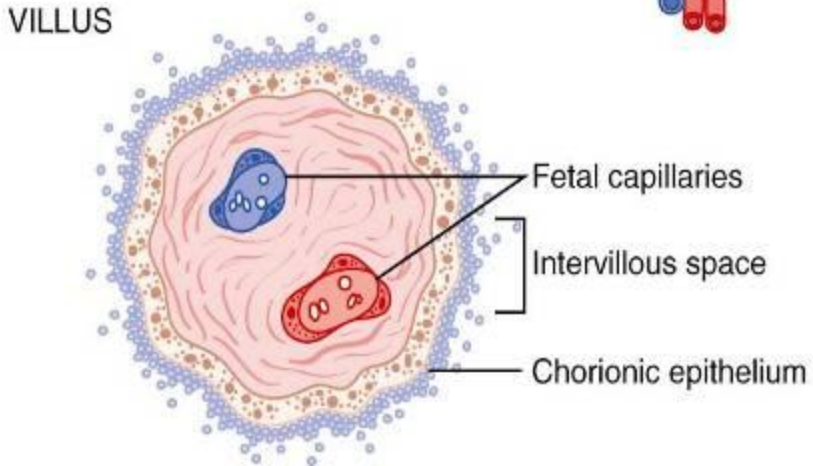
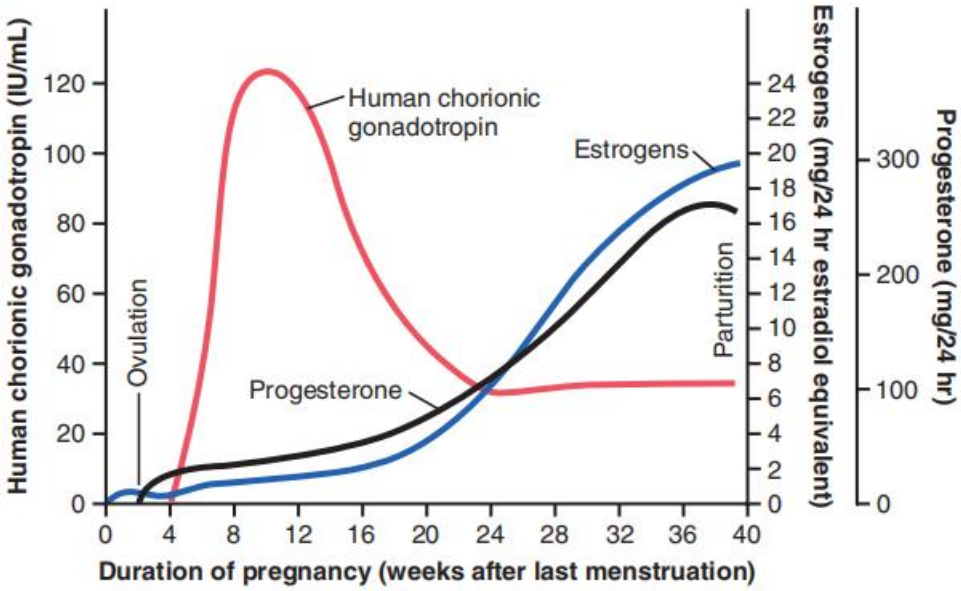


Figure 82-5

Pregnancy hormones

hCG –
secreted by blastocyst (6-8 cells)
then
syncytiotrophoblasts

-- detected within 8-9d of conception (maternal blood and urine)
---maintains Corp.L and Decidua
--If CL removal, 6th-12th abortion
---13th CL involute



Functions of hCG--

1. Produced by syncytiotrophoblasts (8-9 d after fertilization)
2. Maintains corpus luteum beyond normal lifespan
3. Stimulates progesterone and E2 by CL
4. Stimulates essential DHEA-S in fetal zone of adrenal gland
5. Stimulates testosterone production in male fetus –male organs and descending testes
6. hCG receptors in endometrium and myometrium and can inhibit contractions produced by oxytocin
7. Immunosuppressant

Trophoblasts differentiate into 2 layers:

inner - cytotrophoblast -- well-defined cells, rapidly proliferating—invade spiral arteries

outer - syncytiotrophoblast -- multinucleated mass without cellular boundaries -- placental steroid and hormone production -- line intervillus space, opposite of deciduum -- exposed directly to maternal blood

-- protrusions release TNFα -- penetrates basement membrane of uterine epithelial cells and to help cells reach the uterine stroma

Implantation of the blastocyst, invasion of cyto- and syncitio-trophoblasts.

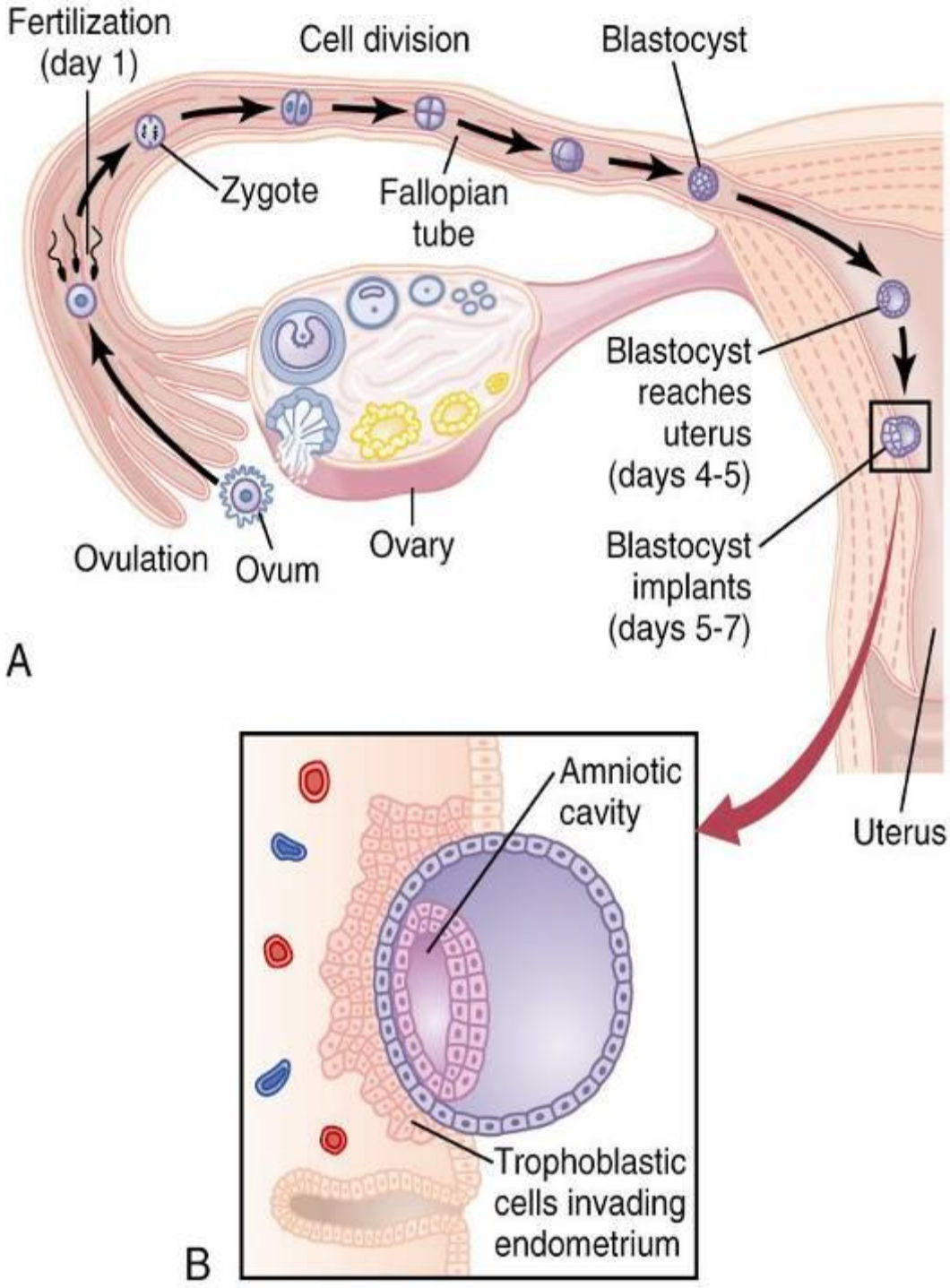
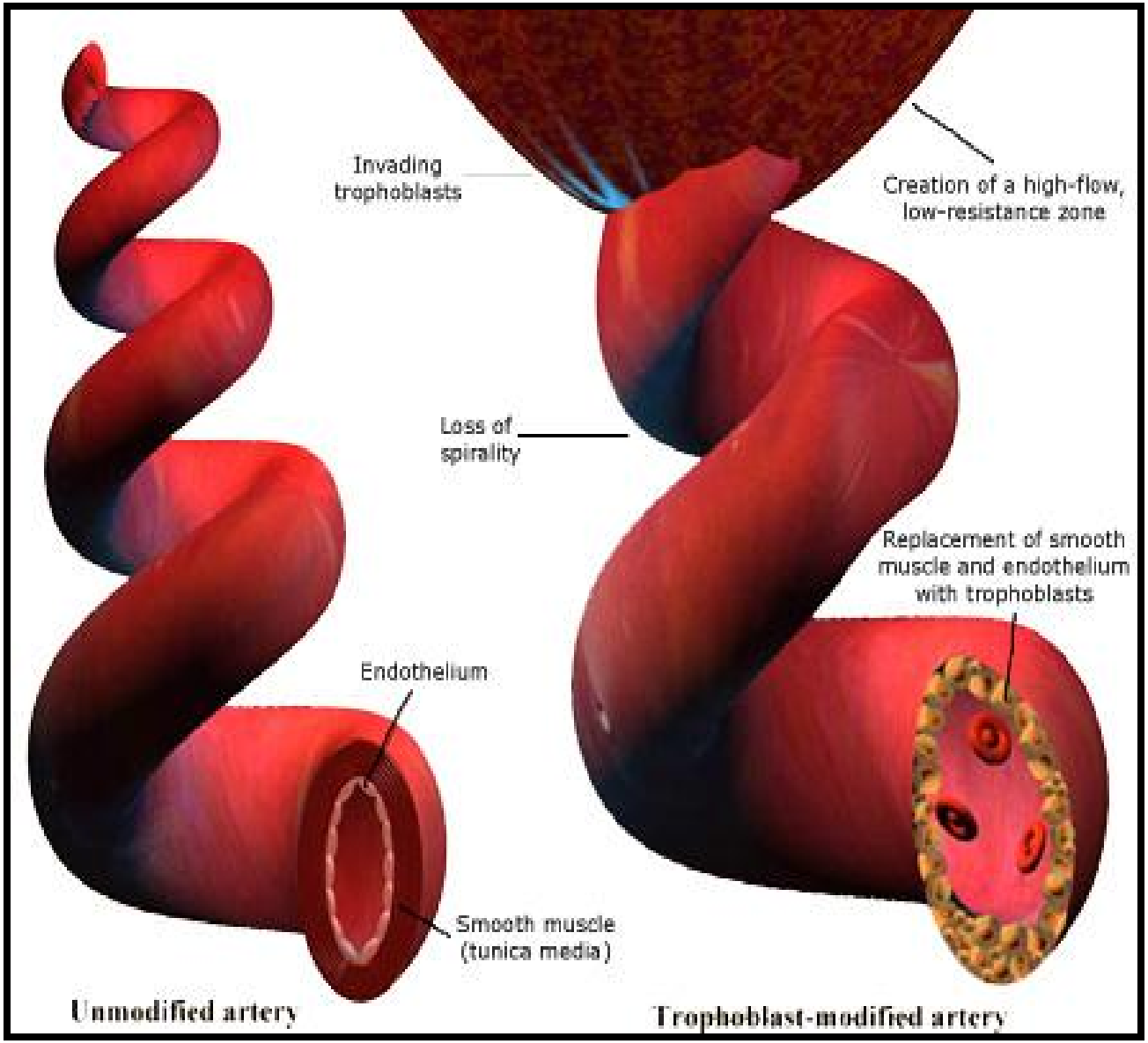


Figure 82-2

SPIRAL ARTERIES



Factors which contribute to trophoblast differentiation: growth factors (IGF, TGF, EGF) and cytokines

Cytotrophoblasts and syncytiotrophoblasts /placental-hypothalamic-pitutiary relation:

Early pregnancy:
Placenta (syncytiotrophoblast) → **hCG**
hCG acts like **LH**
Maintains corpus luteum → progesterone continues
Later pregnancy:
Placenta produces:
- **Estrogen**
- **Progesterone**

These hormones **suppress GnRH, LH, FSH**
So:
Normal axis (Hypothalamus → Pituitary → Ovary) is **suppressed**
Placenta becomes the **dominant endocrine controller**

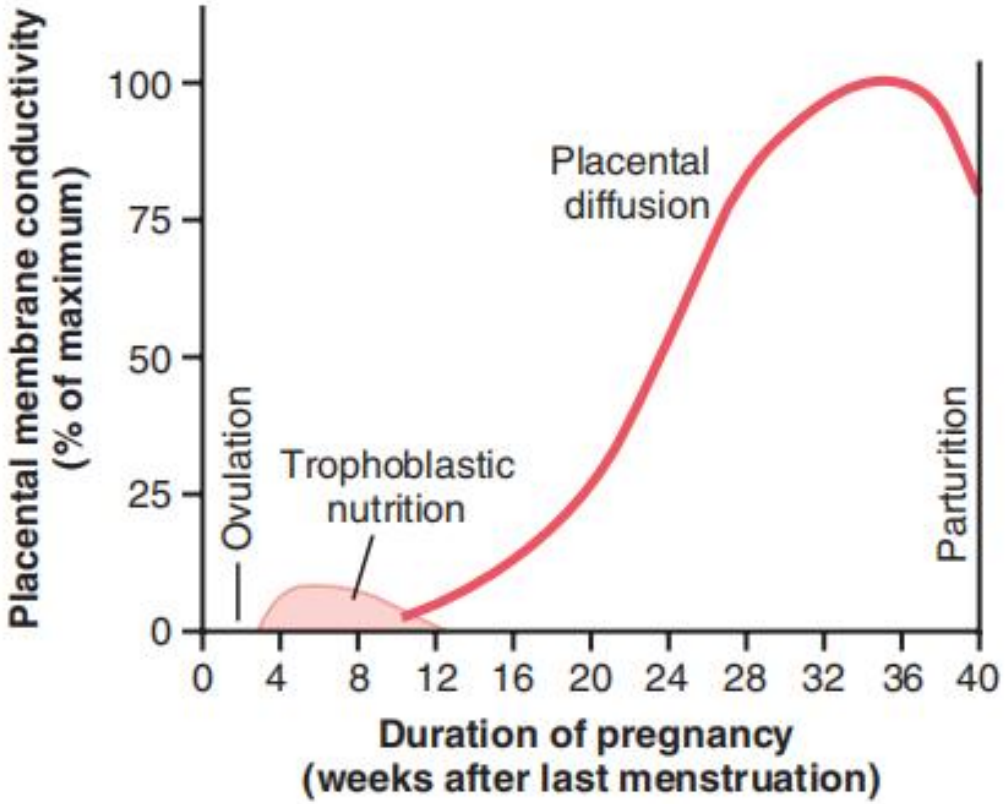
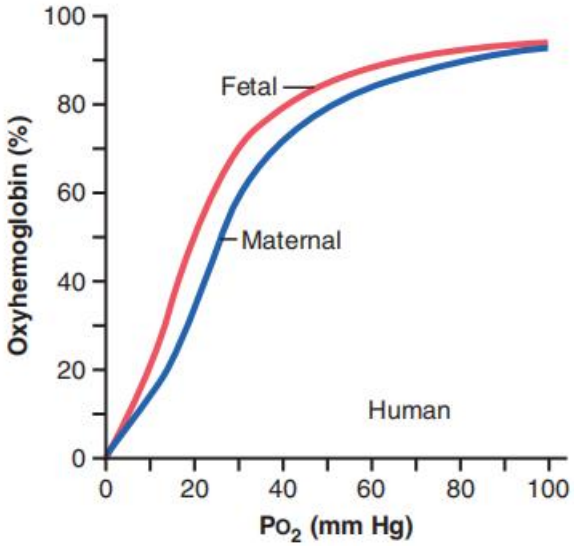


Figure 83-4. Nutrition of the fetus. Most of the early nutrition is due to trophoblastic digestion and absorption of nutrients from the endometrial decidua, and essentially all the later nutrition results from diffusion through the placental membrane.

Organization of the mature placenta and intervillus space.



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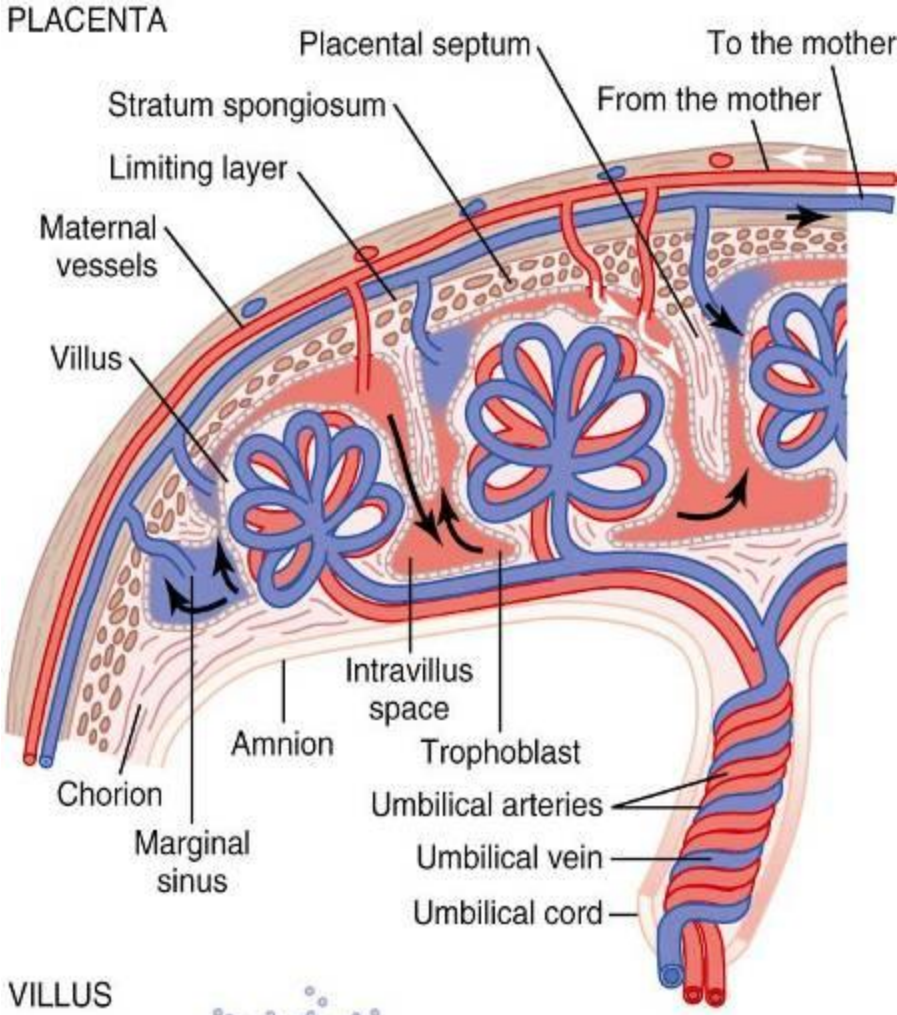


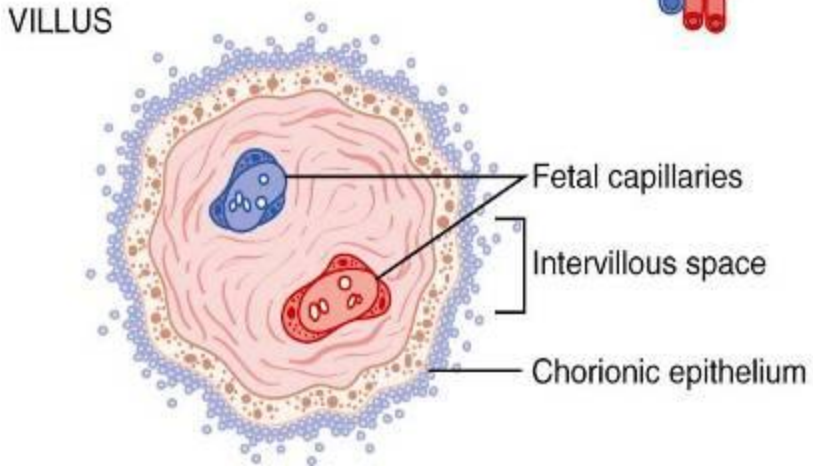


Figure 82-5

Functions of the placenta

1. Fetal gut in supplying nutrients
2. Fetal lung in exchanging O2 and CO2
3. The fetal kidney in regulating fluid volumes and disposing of waste metabolites
4. Endocrine gland synthesizing many steroids and protein hormones that affect both maternal and fetal metabolism

DIFFUSION IN PLACENTA

- In the early months of pregnancy, the placental membrane is still thick because it is not fully developed. Therefore, its permeability is low. Further, the surface area is small because the placenta has not grown significantly. Therefore, the total diffusion conductance is minuscule
- in later pregnancy, the permeability increases because of thinning of the membrane diffusion layers and because the surface area expands many times over, thus giving the tremendous increase in placental diffusion shown
- the mean pressure gradient for diffusion of oxygen through the placental membrane is about 20 mm Hg (50 mat-30 fet).

LOW O2 GRAD. BUT ENOUGH EXCHANGE

- First, *fetal hemoglobin,* curve of fetal hemoglobin is shifted to the left of that for maternal hemoglobin.

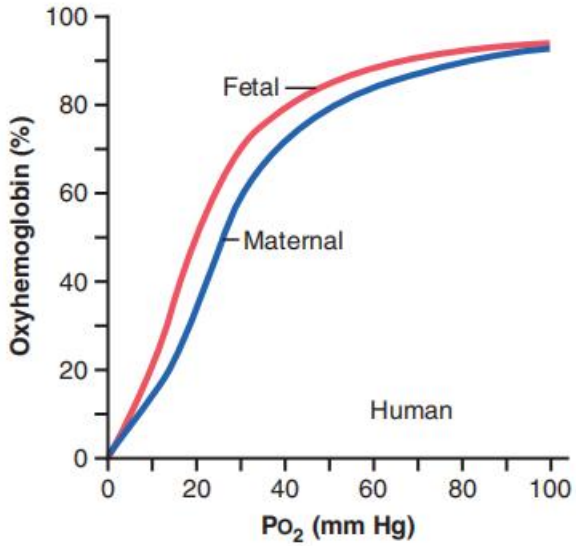
(This means that at the low PO2 levels in fetal blood, the fetal hemoglobin can carry 20 to 50 percent more oxygen than can maternal hemoglobin.)

- Second, the *hemoglobin concentration of fetal blood is about 50 percent greater than that of the mother,* more important factor in enhancing the amount of oxygen transported to the fetal tissues.
- Third, the *Bohr effect,* enhances the transport of oxygen by fetal blood.

(hemoglobin can carry more oxygen at a low PCO2 than it can at a high CO2.) Loss of the carbon dioxide from bay to maternal makes the fetal blood more alkaline, whereas the increased carbon dioxide in the maternal blood makes it more acidic.

OXYGEN EXCHANGE

- total *diffusing capacity* of the entire placenta for oxygen at term is about 1.2 milliliters of oxygen per minute /mmhg



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CO2 TRANSPORT

- The only means for excreting the fetal CO2 is through the placenta into the mother's blood.
- The partial pressure of carbon dioxide (PCO2) of the fetal blood is 2 to 3 mm Hg higher than that of the maternal blood.
- Small but more than sufficient to allow adequate diffusion of carbon dioxide
- Due to the extreme solubility of carbon dioxide in the placental membrane allows carbon dioxide to diffuse about 20 times as rapidly as oxygen.