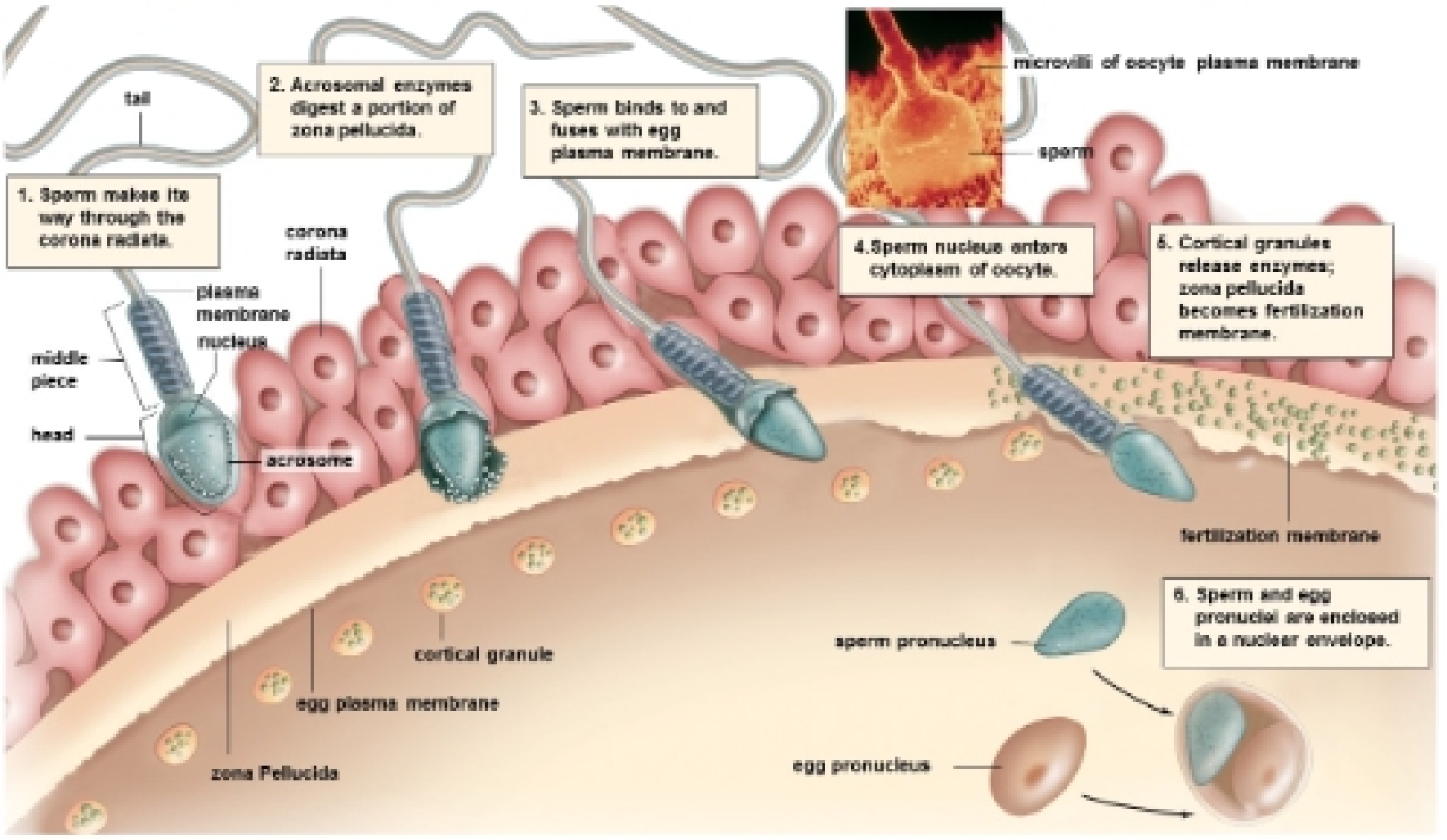
Chapter 17: Fertilization, Embryonic Development & Aging

Fertilization:

- ✓ Fertilization is the union of the sperm and egg to form a zygote.
- ✓ Egg is surrounded by an outer matrix called the zona pellucida.
- ✓ Outside this matrix it has a few layers of follicular cells collectively called the corona radiata.



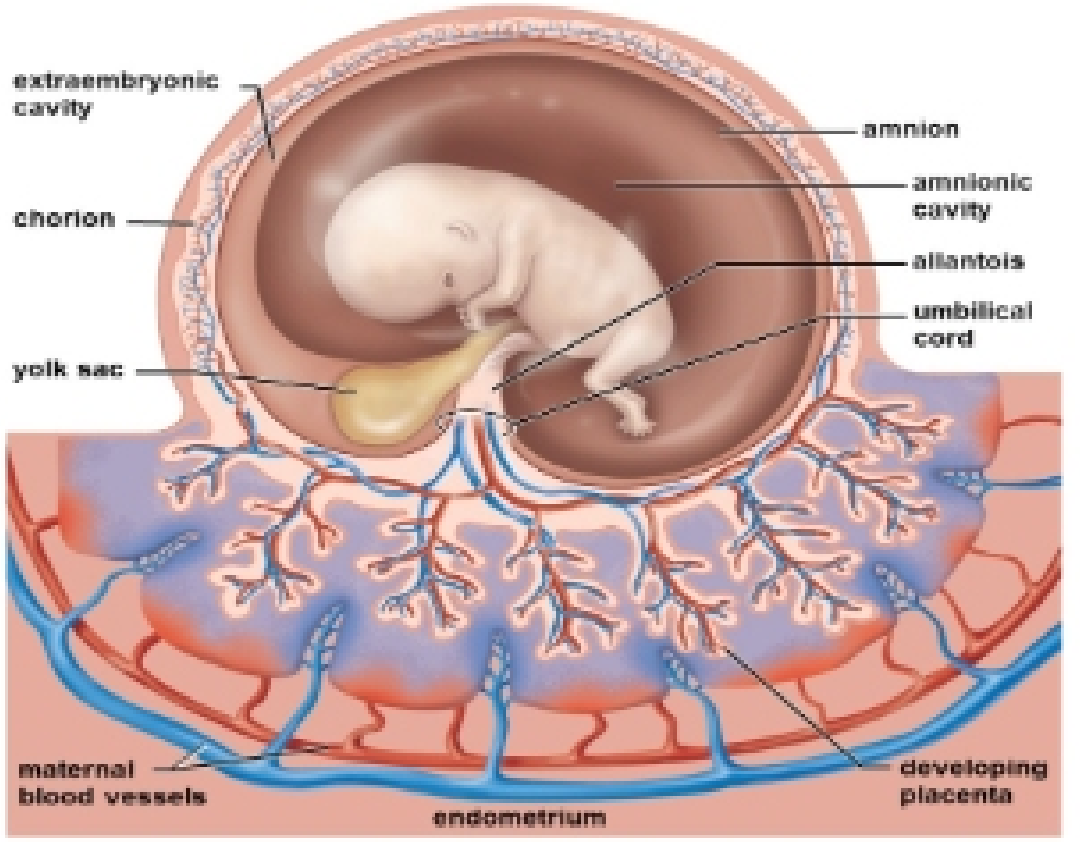
What prevents more than one sperm from entering?

- ✓ Once a sperm has fertilized an egg, the egg's plasma membrane changes to prevent other sperms from binding.
- ✓ Vesicles within the egg release enzymes that cause the zona pellucida to become impenetrable and further sperms cannot bind.

What are the main processes of development?

- ✓ Cleavage & Blastulation – cells undergo division without the embryo increasing in size
- ✓ Growth – cells undergo division as well as increase in size
- ✓ Morphogenesis & Gastrulation – the embryo begins to take shape as cells migrate to form the primary germ layers – ectoderm (skin), mesoderm (muscle) & endoderm (organs)
- ✓ Differentiation – when cells take on specific structure and function (the nervous system is the first visible system)

Extraembryonic membrane



- ✓ Chorion – fetal half of the placenta, the organ that provides the embryo with nourishment and gets rid of wastes
- ✓ Allantois – gives rise to the bladder and the blood vessels of the umbilical cord that carry blood to and from the fetus
- ✓ Yolk sac – contains many blood vessels and where blood cells first form (there is little yolk in humans)
- ✓ Amnion – contains amniotic fluid that cushions and protects the embryo.

What are the stages of development?

1. Pre-embryonic development - 1st week of development after fertilization
2. Embryonic development – 2nd week after fertilization until the end of the 2nd month
3. Fetal development – the 3rd through the 9th months of development
4. Development after birth – stages of life including infancy, childhood, adolescence, and adulthood

Preventing birth defects

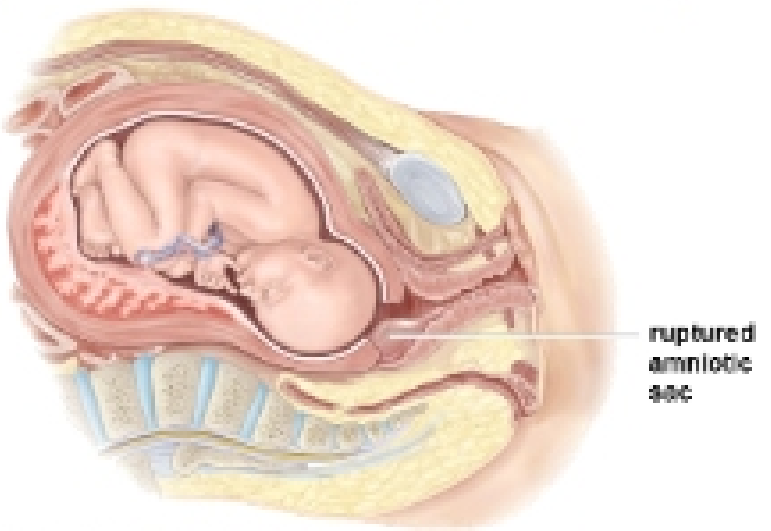
- ✓ Get physical exams by a trained doctor.
- ✓ Have good health habits: proper nutrition and adequate sleep and exercise.
- ✓ Avoid smoking, alcohol and drug abuse.
- ✓ Avoid having X-rays.
- ✓ Avoid certain medications and supplements.
- ✓ Avoid sexually transmitted diseases or know if you have one.

Birth

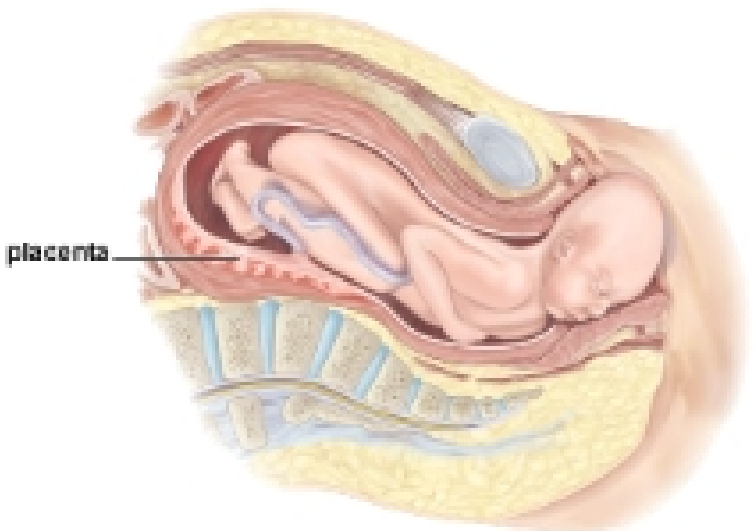
- ✓ True labor is characterized by uterine contractions (induced by oxytocin hormone – positive feedback)
- ✓ Uterine contractions occur every 15-20 minutes and last for at least 40 seconds each
  - lead to childbirth ('parturition').

Development of the sex organs

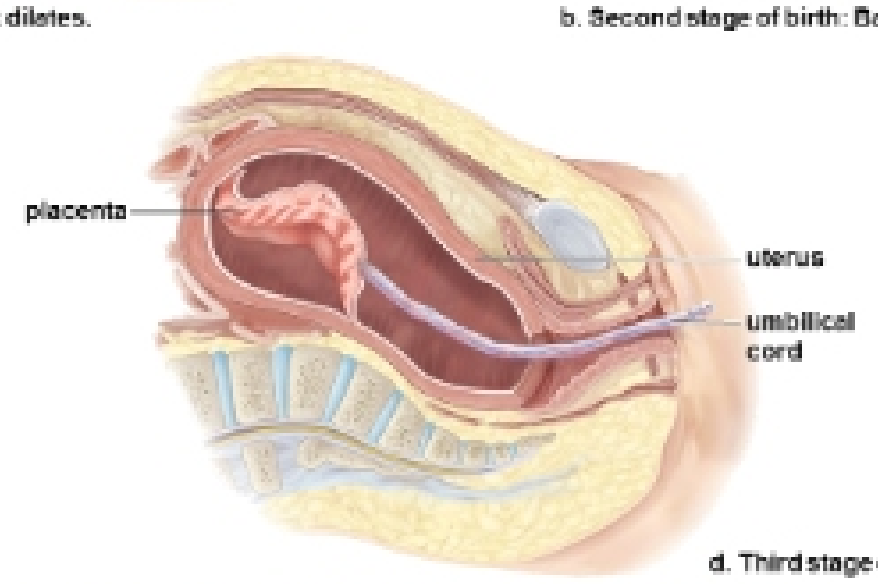
- ✓ Sex of an individual is determined at conception (XX is female and XY is male).
- ✓ If the SRY (the sex-determining region on the Y chromosome) gene encoding TDF (testis determining factor) is present at week 6 then the embryo develops into a male.
- ✓ Anti-Müllerian hormone secreted by the testes prevents the development of female sex organs.
- ✓ At 14 weeks, primitive testes and ovaries are already developing.
- ✓ The development of the external organs is dependent on the presence or absence of dihydrotestosterone (DHT) produced by the testes.



a. First stage of birth: Cervix dilates.



b. Second stage of birth: Baby emerges.



d. Third stage of birth: Afterbirth is expelled.

Aging

- ✓ Stages of life: infancy, childhood, adolescence, and adulthood
- ✓ Hypotheses of aging
- ✓ Cellular aging: there may be hormonal and genetic influences on aging; mitochondrial activity and caloric intake may be involved

- ✓ Damage accumulation: aging may result from the accumulation of damage—some avoidable, some unavoidable—over time

What are the effects of age on body systems?

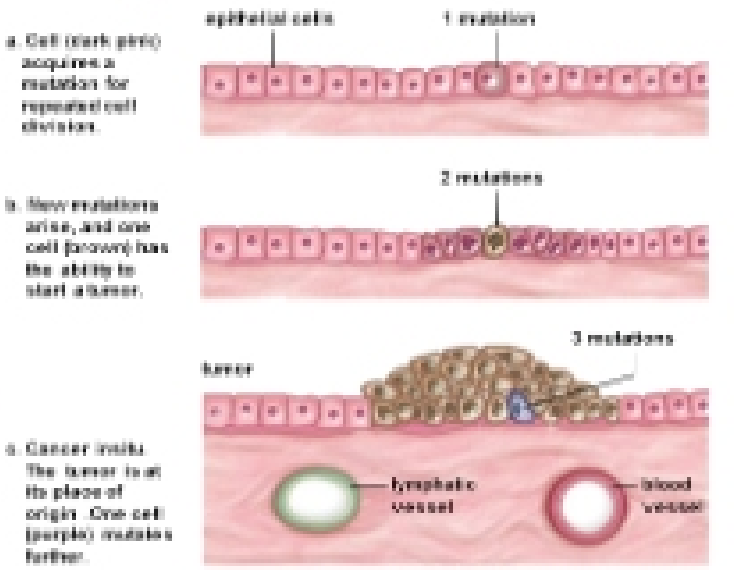
- ✓ Skin becomes thinner, less elastic, and dry.
- ✓ Less adipose tissue in the skin, so one feels cold more easily.
- ✓ Decrease in melanocytes leading to gray hair, while some of the remaining cells are larger leaving "age spots" (dark spots on the skin).
- ✓ Heart shrinks and arteries become more rigid.
- ✓ Reaction time slows and senses are muted.
- ✓ Lenses in the eyes lose ability to accommodate.
- ✓ Blood pressure usually increases.
- ✓ Bone density declines.
- ✓ Muscle mass decreases.
- ✓ Weight gain results from a decrease in metabolism and an increase in inactivity.
- ✓ Females undergo menopause and males andropause.

* Although many changes occur in the body as we age, some of them can be tempered or even reversed by understanding what extrinsic factors can be controlled to decrease these changes.

Chapter 19: Cancer

Characteristics of cancer cells

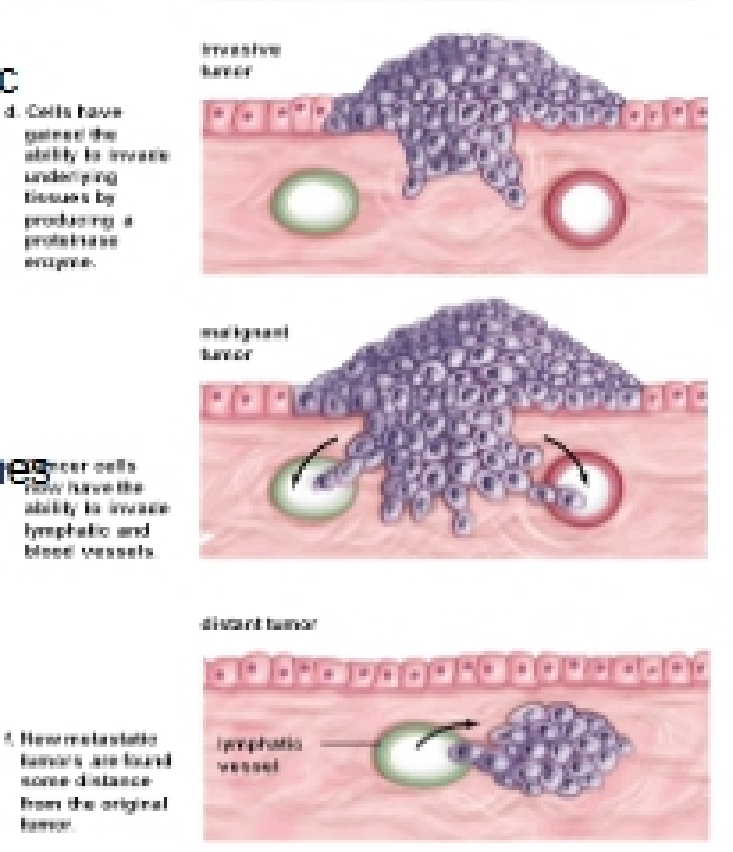
- o Lack differentiation and do not contribute to body functioning. (They can't differentiate into other cells, no formation of an advanced cell type) (Proteins that prevent mutations are messed up and can't stop the mistake)
- o Have abnormal nuclei that are enlarged and may have an abnormal number of chromosomes
- o Unlimited, uncontrolled ability to divide
- o Form tumors
  - ▪ Benign tumors are usually encapsulated and do not invade adjacent tissue, while a cancerous tumor usually is not encapsulated and eventually invades surrounding tissue.
- o Can divide without growth factors
- o Become abnormal gradually through a multistage process
- o Undergo angiogenesis and metastasis



3 phases in the development of cancer cells

1. Initiation – a single cell undergoes a mutation that causes it to divide repeatedly
2. Promotion – a tumor develops and cells within the tumor mutate
3. Progression – a cell mutates in such a way that allows it to invade surrounding tissue

- ❖ Angiogenesis is the formation of new blood vessels to supply nutrients and oxygen to the tumor.
- ❖ Metastasis occurs when cells move into the bloodstream or lymphatic vessels and form new tumors at distant sites from the primary tumor.



The genetic basis for cancer

- o Proto-oncogenes – genes encoding proteins that promote the cell cycle and prevent unwanted cell death (apoptosis)
- o Tumor suppressor genes – eg. p53; products inhibit the cell cycle and promote apoptosis
- o Mutations in these genes can cause cancer. Mutated proto-oncogenes OR tumor-suppressor are cancer-causing genes, called oncogenes.