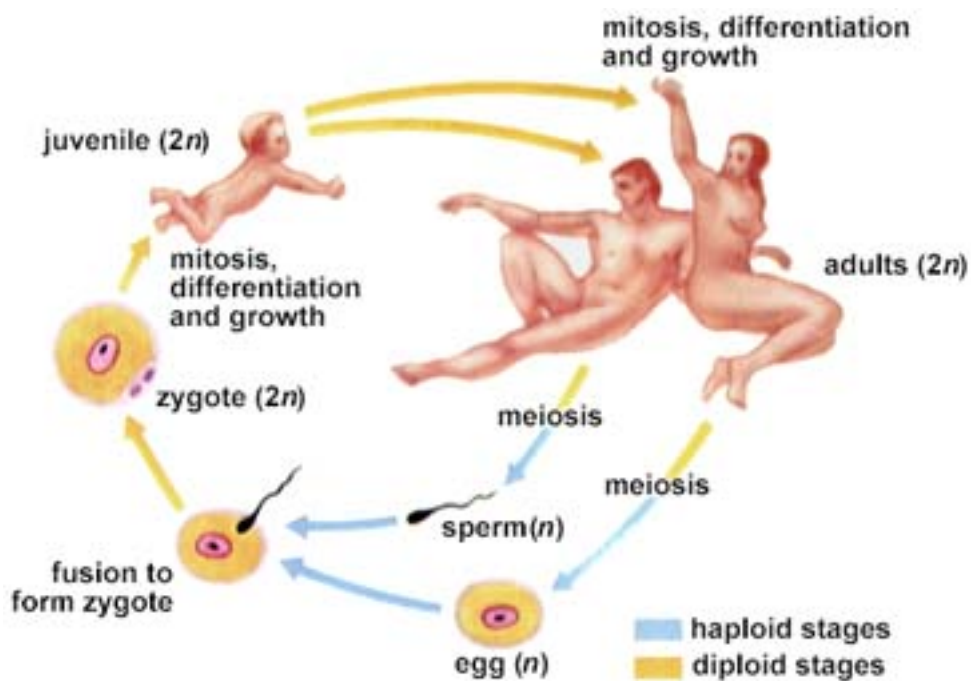


Reading Assignment: Read Chapter 5 of Dr. Hill's Lecture Notes available at my BU web site (recommended reading online, not printing as it is long). You may search for specific terms or topics using the Adobe Acrobat Reader search tool (binoculars). There is NOT a corresponding chapter in your APHNT text book.

Embryological Development Overview –

Human life cycle:



Gametogenesis –

Fertilization –

A. Spermatogenesis and Oogenesis

1) Spermatogenesis –

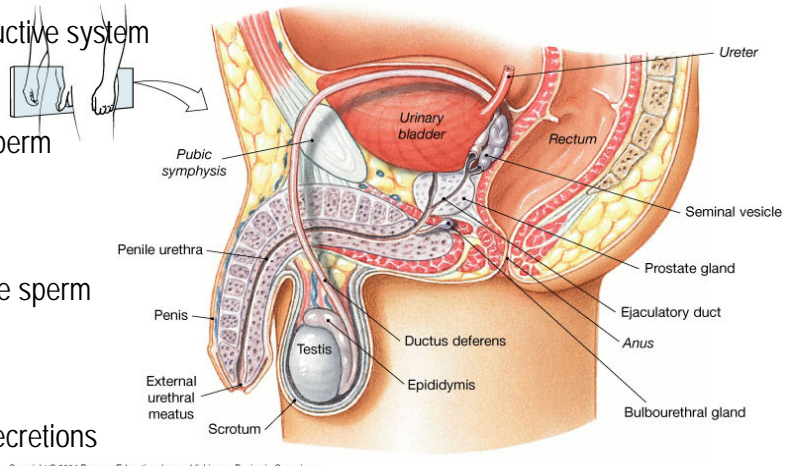
a) anatomy of the male reproductive system

Testis – contains seminiferous tubules, synthesizes sperm

Epididymis – stores sperm

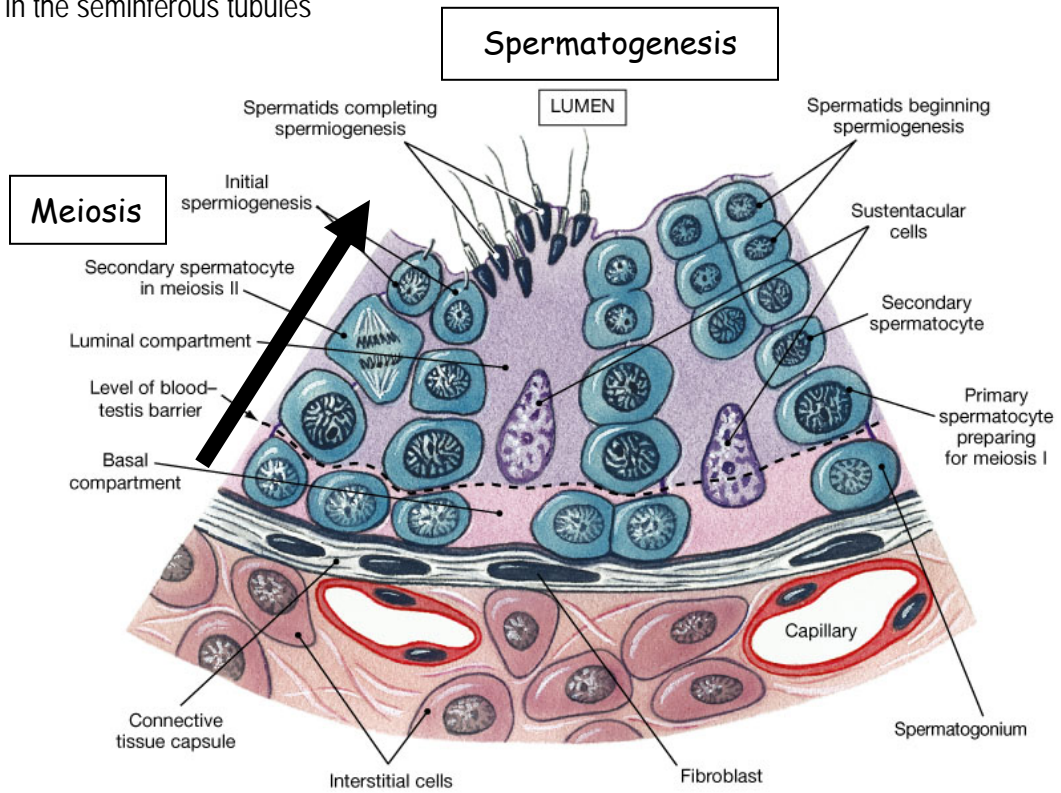
Ductus deferens – tube to move sperm to seminal vesicle

Seminal vesicle
Prostate gland
Bulbourethral gland } add secretions



Penis (penile urethra + corpora cavernosa + corpora spongiosum) – shared organ of urinary and reproductive systems, erectile tissues fill with blood during use as a copulatory organ

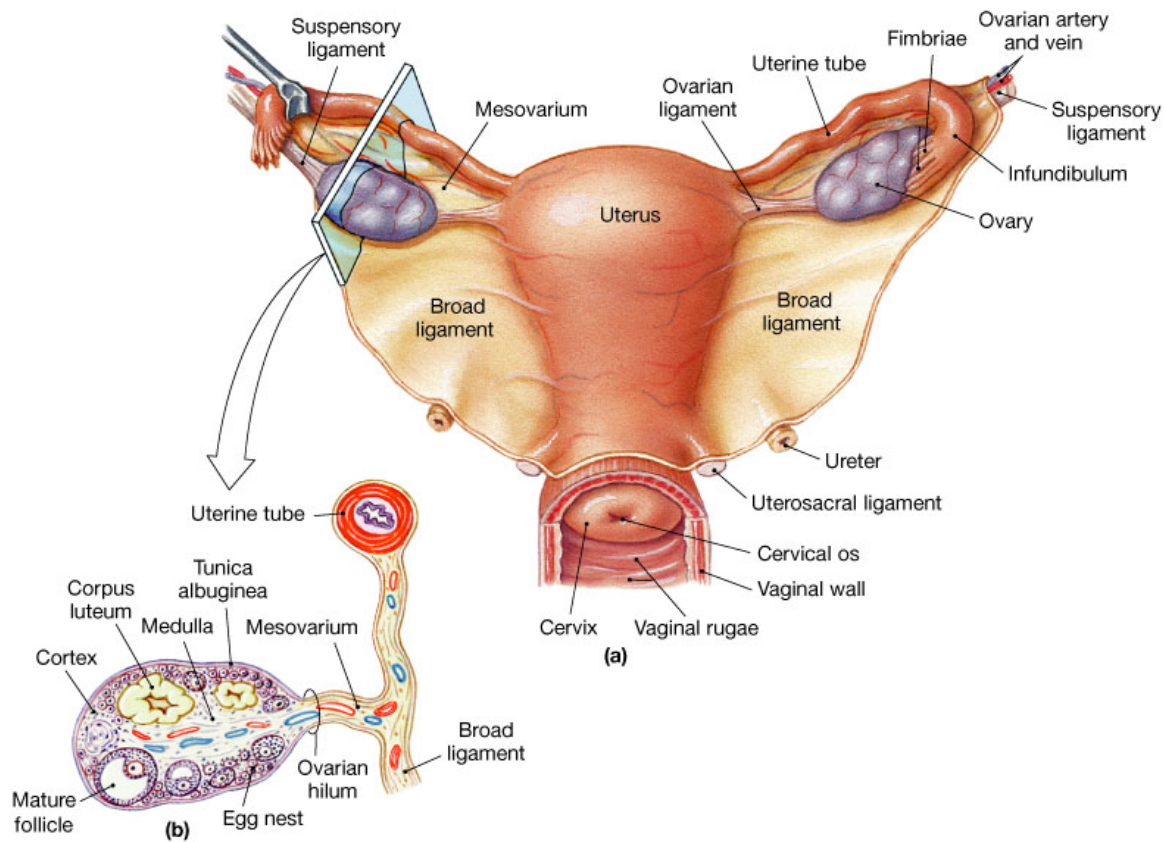
b) events in the seminiferous tubules



(c)

2) Oogenesis –

a) anatomy of the female reproductive tract:



Ovary – organ that houses developing ova within follicles

Follicles – nutritive and secretory cells surrounding developing ova

Corpus luteum – secretory cells that reorganize to secrete sex hormones after ovulation;
yellow body

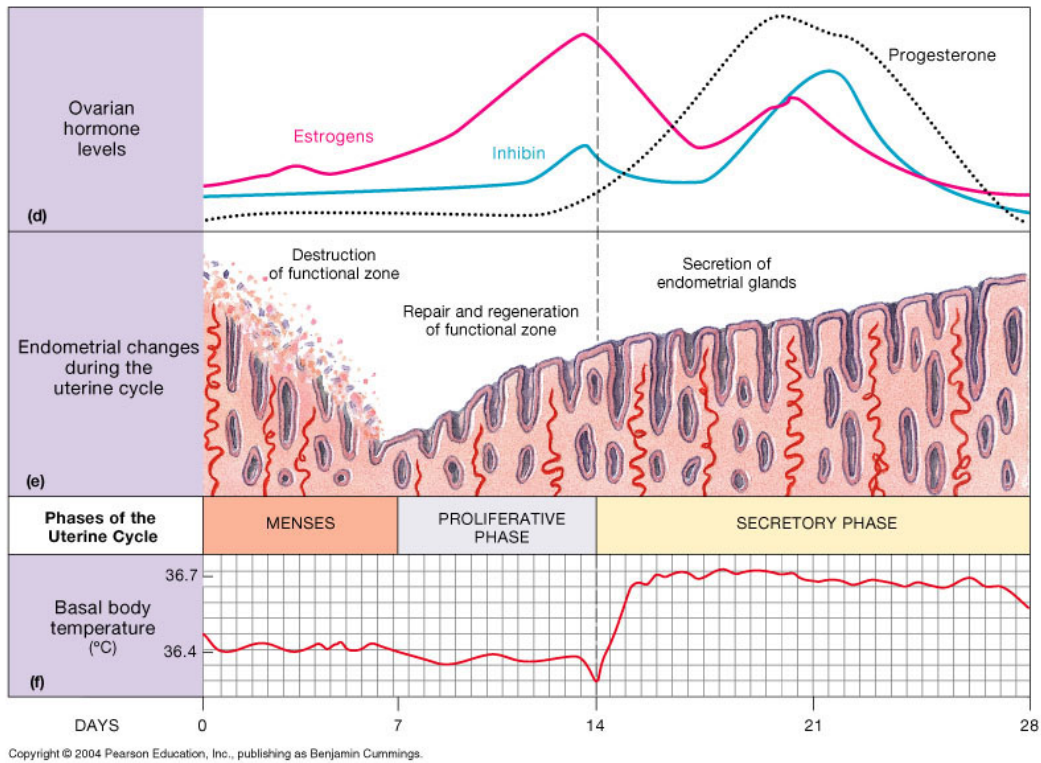
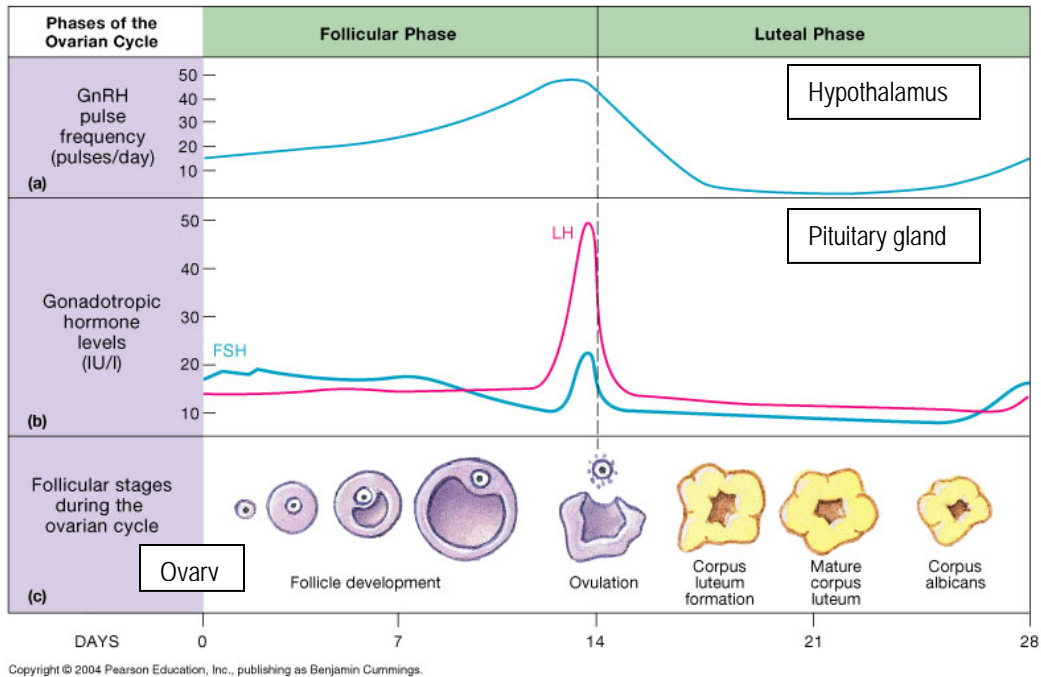
Fallopian (uterine) tube – duct that provides passage for ovum to the uterus; usual site of fertilization that results in successful implantation

Uterus – organ that provides for implantation of the embryo; contains muscular myometrium (=smooth muscle) and highly vascularized endometrium (=stratified squamous epithelium and underlying tissues).

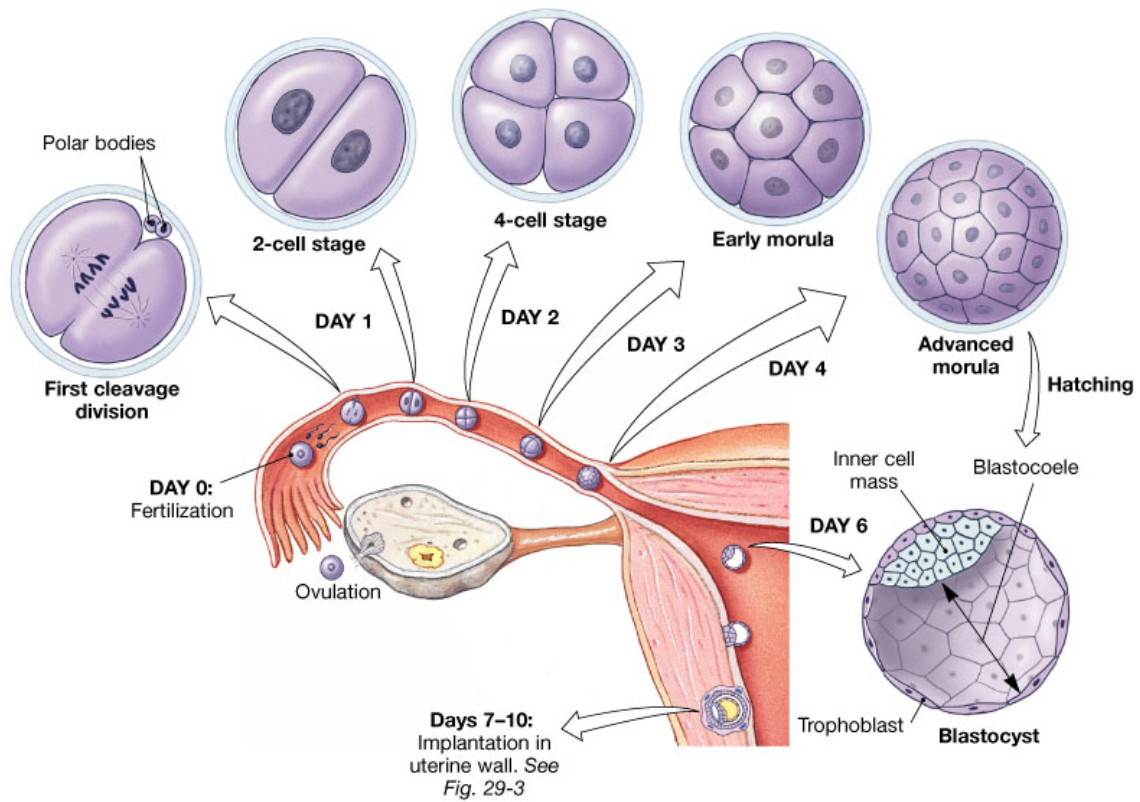
Cervix – is the lower, narrow portion of the uterus where it joins with the top end of the vagina

Vagina – (from Latin, literally "sheath" or "scabbard") is the tubular tract leading from the uterus to the exterior of the body in female; an elastic muscular tube about 4 inches (100 mm) long and 1 inch (25 mm) in diameter.

b) Menstrual cycle and ovulation –



B. Fertilization –



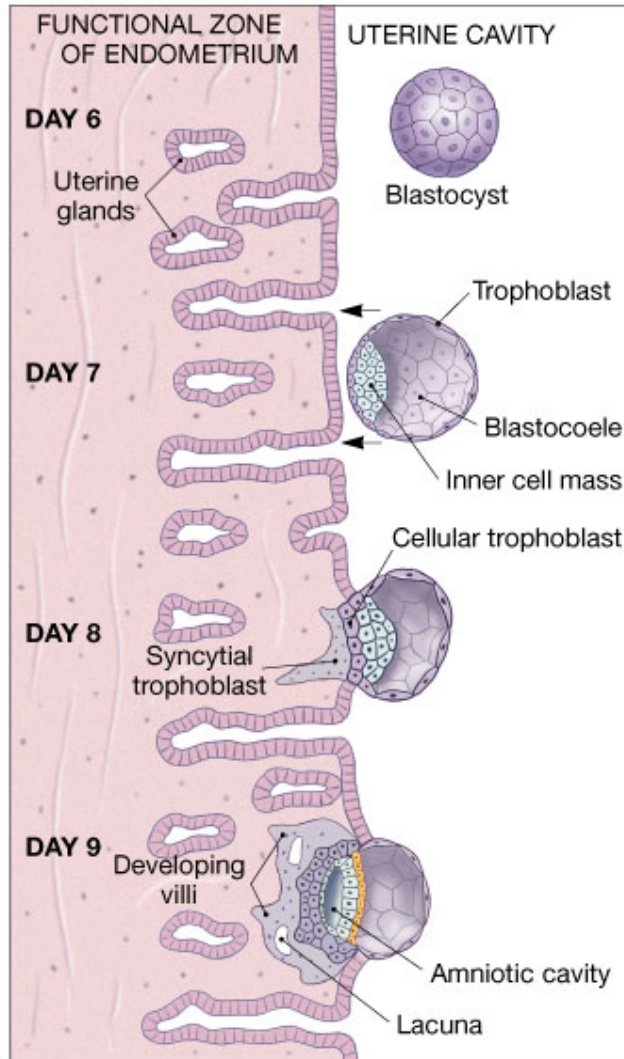
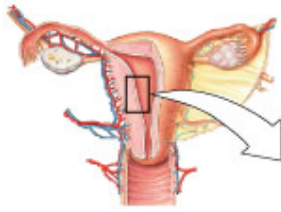
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C. The First Embryonic Month

1) Cleavage Stages –

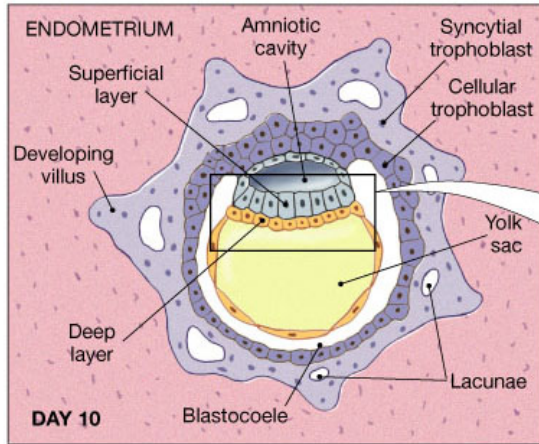
2) Morula –

3) Blastocyst (trophoblast + inner cell mass) –



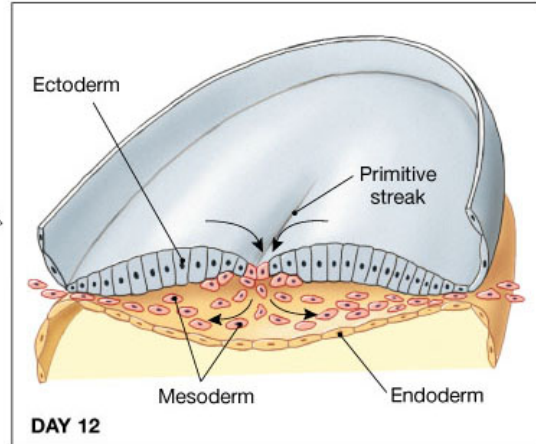
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4) Gastrulation –



The inner cell mass begins as two layers: a superficial layer, facing the amniotic cavity, and a deep layer, exposed to the blastocoele. Migration of cells around the amniotic cavity is the first step in the formation of the amnion. Migration of cells around the edges of the blastocoele is the first step in yolk sac formation.

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Migration of superficial cells into the interior creates a third layer. From the time this process (gastrulation) begins, the superficial layer is called *ectoderm*, the deep layer *endoderm*, and the migrating cells *mesoderm*.

a) Ectoderm –

b) Mesoderm –

c) Endoderm –

Table 1. STRUCTURES FORMED BY THE THREE PRIMARY GERM LAYERS*

ENDODERM:

Epithelium of the digestive tract and its glands (e.g., the liver and the pancreas)

Epithelium of the urinary bladder and the urethra

Epithelium of the pharynx, the auditory tube, the larynx, the trachea, the bronchi, and the lungs.

Epithelium of the tonsils, the thyroid, parathyroid, and thymus glands

Adenohypophysis (anterior pituitary gland)

MESODERM:

Skeletal, smooth, and cardiac muscle

Cartilage, bone, and other connective tissues

Blood, bone marrow, and lymphoid tissue

Epithelium of blood vessels and lymphatics

Epithelium of the joint cavities

Epithelium of the kidneys and the ureters

Epithelium of the gonads and reproductive ducts

Epithelium of the adrenal cortex

Dermis of the skin

ECTODERM

Epidermis of the skin

Hair, nails and glands of the skin

Lens of the eye

Receptor cells of the sense organs

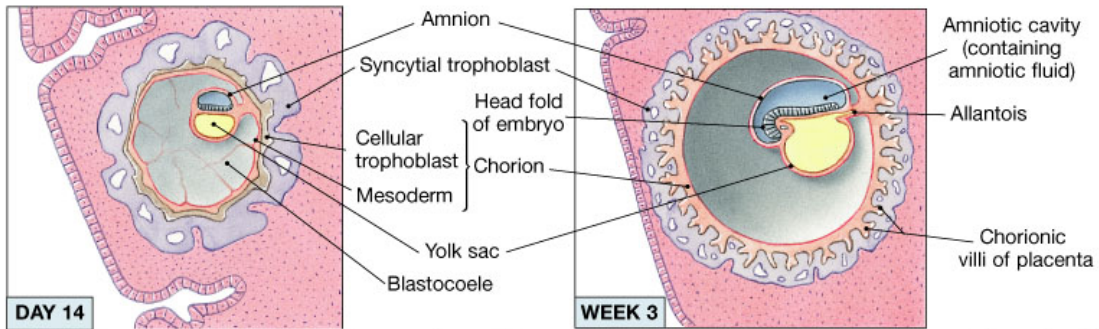
Epithelium of the mouth, the nostrils, the sinuses, and the anal canal

Enamel of the teeth

All nervous tissue, except the adenohypophysis (anterior pituitary gland)

Adrenal medulla

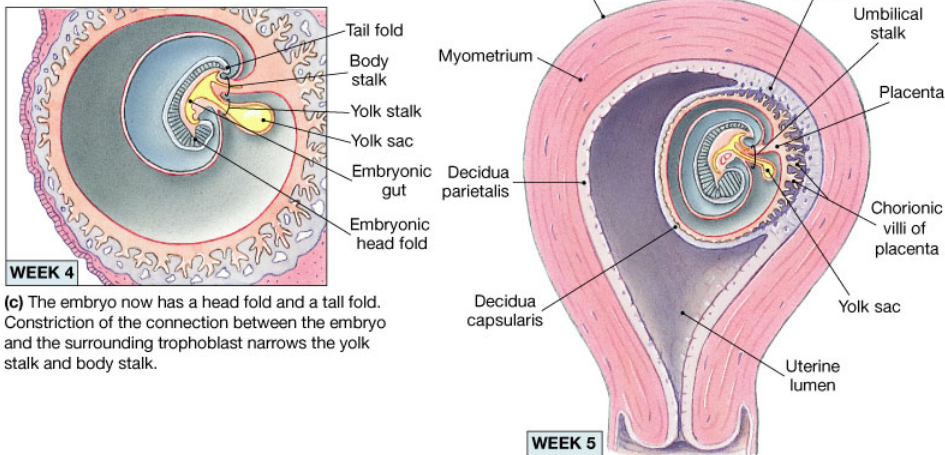
5) Formation of the Extraembryonic Membranes –



(a) Migration of mesoderm around the inner surface of the trophoblast creates the chorion. Mesodermal migration around the outside of the amniotic cavity, between the ectodermal cells and the trophoblast, forms the amnion. Mesodermal migration around the endodermal pouch creates the yolk sac.

(b) The embryonic disc bulges into the amniotic cavity at the head fold. The allantois, an endodermal extension surrounded by mesoderm, extends toward the trophoblast.

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(c) The embryo now has a head fold and a tail fold. Constriction of the connection between the embryo and the surrounding trophoblast narrows the yolk stalk and body stalk.

(d) The developing embryo and extraembryonic membranes bulge into the uterine cavity. The trophoblast pushing out into the uterine lumen remains covered by endometrium but no longer participates in nutrient absorption and embryo support. The embryo moves away from the placenta, and the body stalk and yolk stalk fuse to form an umbilical stalk.

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Extraembryonic membranes –

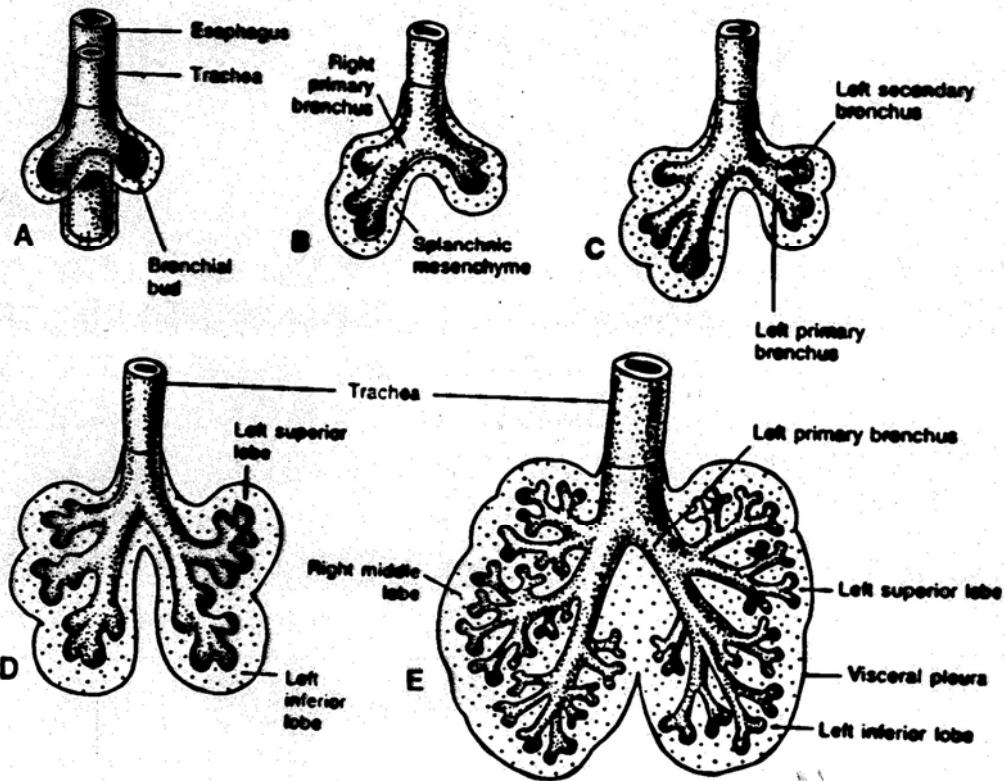
Chorion –

Amnion –

Allantois –

Yolk Sac –

2) Respiratory System –

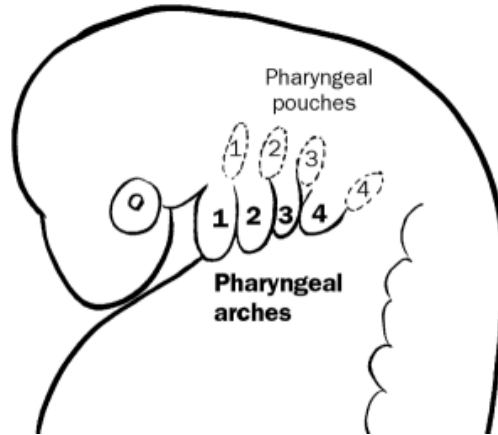


Week	Developmental Events
2-3	Laryngotracheal groove
4	Appearance of branchial buds
5	Formation of primary and secondary bronchi
8	General form of lungs has taken place
13-25	Development of lumina, vascularization, formation of lung lobules (tertiary and respiratory bronchioles, alveoli).
26-birth	Respiratory system functional upon birth

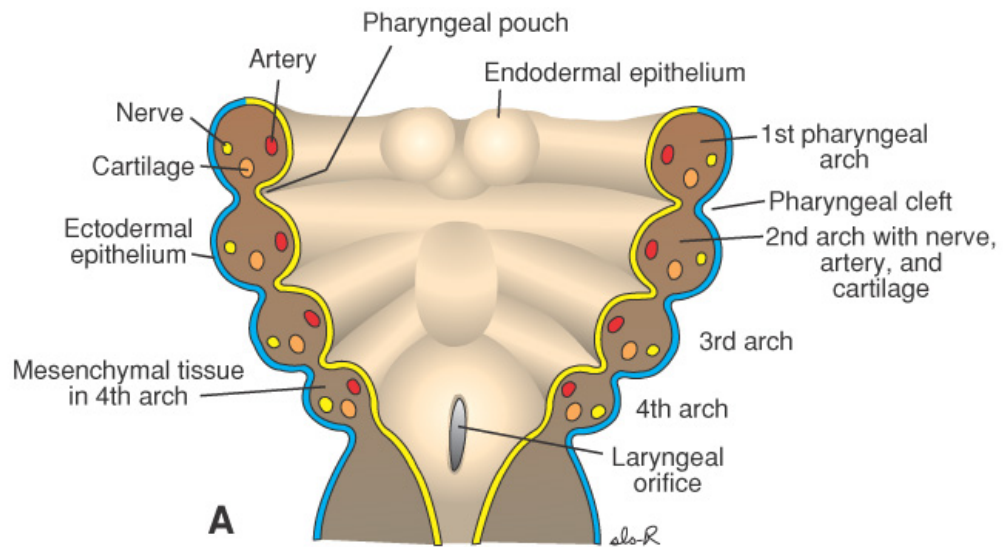
E. Pharyngeal Structures –

1) Overview - the 4-week old embryo develops a distinct branchial apparatus (remnants of gills) that in turn does NOT develop into gills as in fishes but instead develops into structures of the head and neck.

Branchial (pharyngeal) apparatus = branchial arches, pouches, grooves (clefts), and membranes.



Human 4-week old embryo



Branchial (pharyngeal) pouch –

Branchial (pharyngeal) cleft (groove) –

Branchial (pharyngeal) arch –

2) Derivatives of the Branchial (Pharyngeal) Structures –

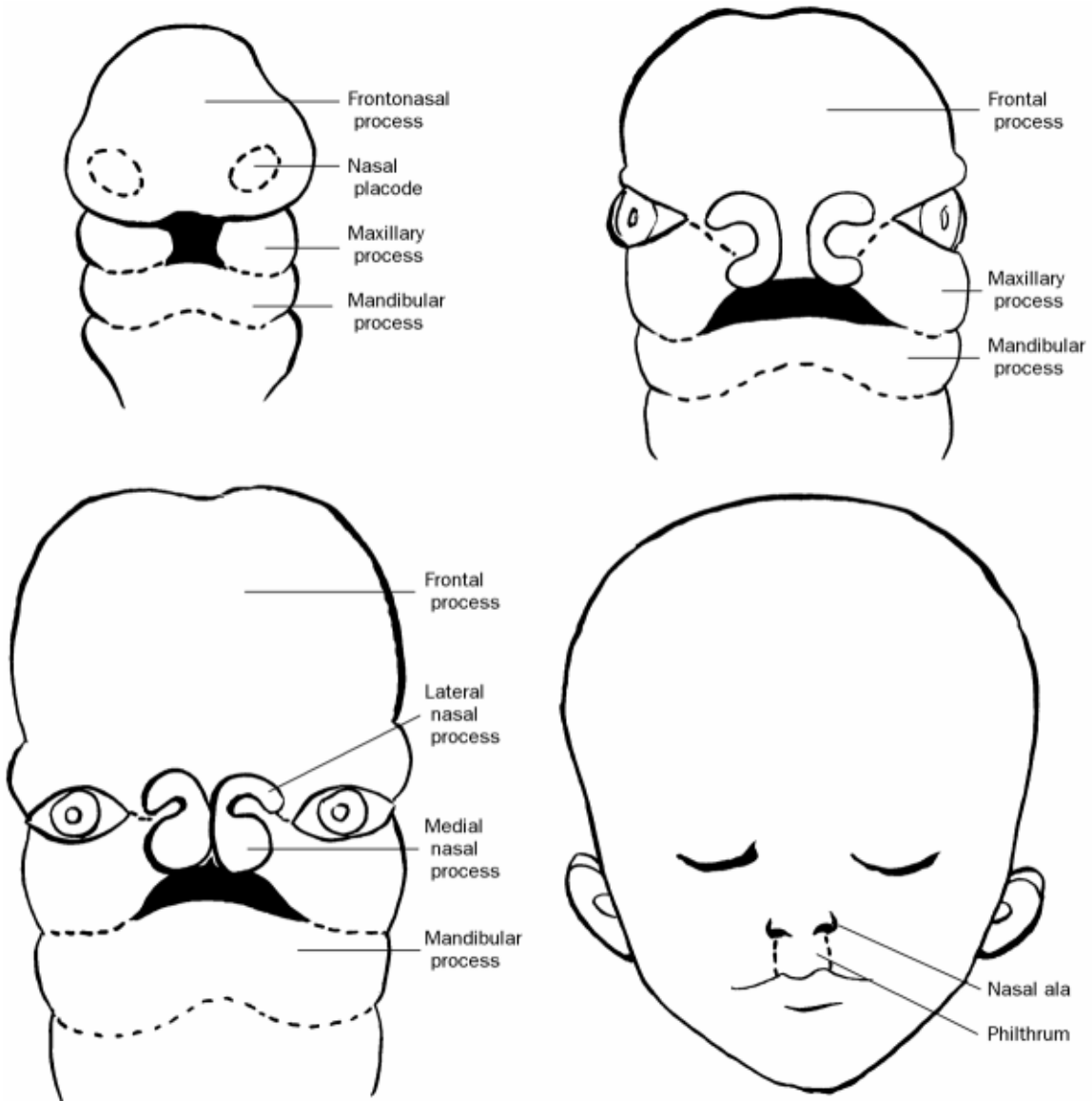
Table 1 - Adult Derivatives of Pharyngeal Arches

Arch	Nerve	Adult Derivatives	
		Muscles (Mesoderm)	Skeletal Structures (Neural Crest)
First (mandibular)	Trigeminal (CN V)	Muscles of mastication, mylohyoid muscle tensor veli palatini muscle, tensor tympani muscle, anterior belly of the digastric muscle	Maxilla, zygomatic bone, temporal bone, palatine bone, vomer, mandible, malleus, incus, sphenomandibular ligament
Second (hyoid)	Facial (CN VII)	Muscles of facial expression, stylohyoid muscle, stapedius muscle posterior belly of digastric muscle	Stapes, styloid process, stylohyoid ligament, lesser horn and superior body of the hyoid bone
Third	Glossopharyngeal (CN IX)	Stylopharyngeus muscle	Greater horn and inferior body of the hyoid bone
Fourth	Vagus (CN X) – Superior laryngeal branch	Muscles of soft palate (except tensor veli palatini) and muscles of pharynx (except stylopharyngeus), cricothyroid muscle, cricopharyngeus muscle,	Thyroid cartilage, cricothyroid cartilage, arytenoid cartilage, laryngeal cartilages
Sixth1[1]	Vagus (CN X) – Recurrent laryngeal branch	Intrinsic muscles of the larynx (except cricothyroid), upper (skeletal) muscles of esophagus	Laryngeal cartilages

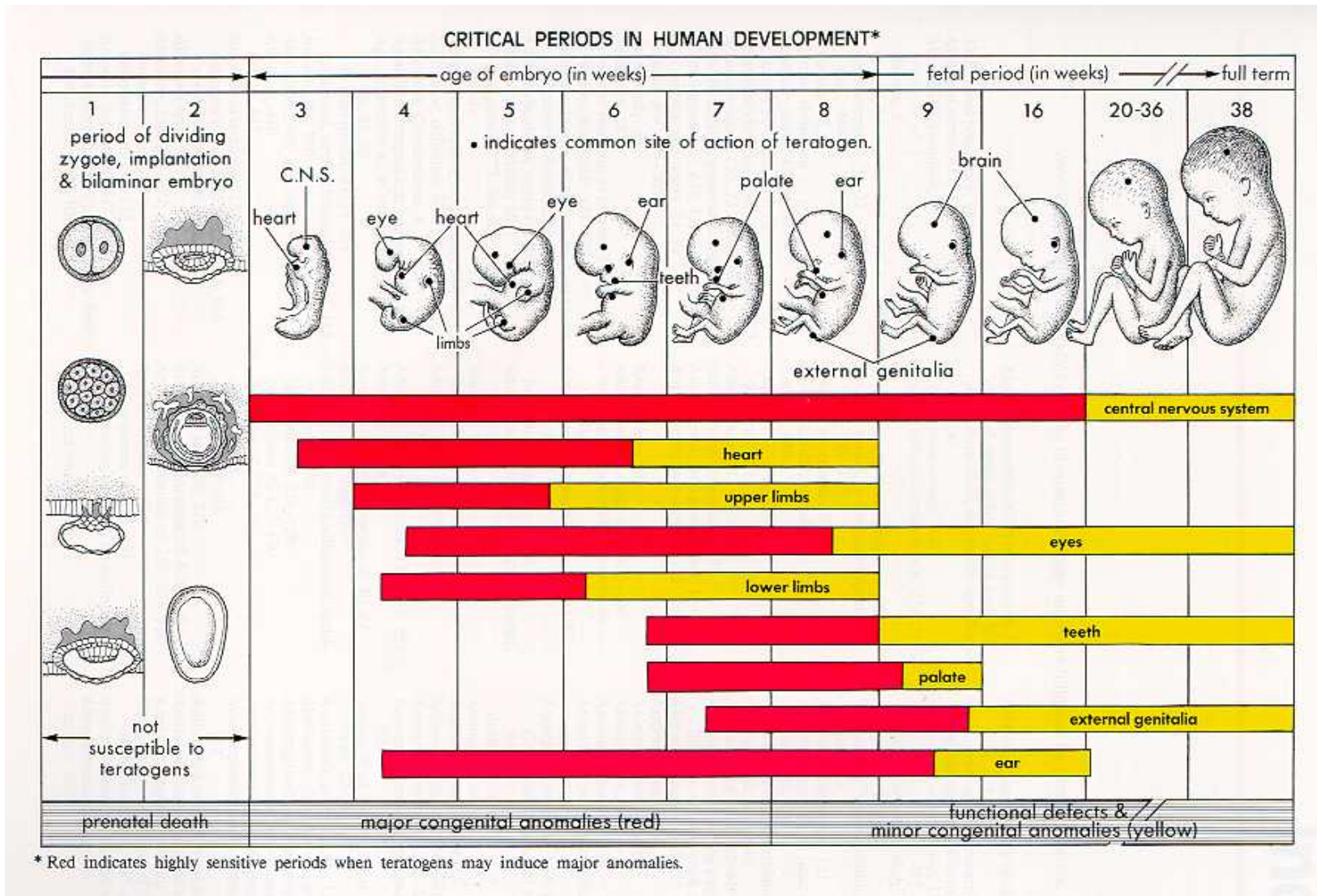
Table Error! Bookmark not defined. - Adult Derivatives of Pharyngeal Pouches

Pouch	Adult derivatives
1	Lining of auditory tube and tympanic cavity (middle ear cavity)
2	Largely obliterated, lining of intratonsillar cleft (tonsillar fossa)
3	Inferior parathyroid glands, thymus
4	Superior parathyroid glands, parafollicular cells of thyroid gland

F. Development of the Face



SUMMARY OF DEVELOPMENT IN ALL SYSTEMS



F. Appearance of Embryo in First Month

Neural tube –

Optic sulcus –

Heart prominence –

Hyoid arch –

Mandibular arch –

Forebrain prominence –

Branchial arches –

Otic pit –

Somites –

Buccopharyngeal membrane –

G. Appearance of the Embryo in Second Month

Brain development –

Cervical sinus –

Anterior nares –

Secondary palate –

Nasal septum –

Philtrum –

Maxillary and globular processes –

Auricles of external ears –

H. Appearance of the Embryo in Third Month

Fetal period –

Ossification = bone formation

Formation of genitalia –

I. Appearance of Embryo in Fourth Month

J. Appearance of Embryo in Fifth Month

Lanugo –

Vernix caseosa –

Amniotic fluid –

Brown fat –

K. Appearance of Embryo in Sixth Month

Clara cells –

L. Appearance of Embryo in Seventh Month

M. Appearance of Embryo in Eighth Month

N. Appearance of Embryo in Ninth Month

O. Problems During Embryological Development

Teratogens –

Cleft palate -



REVIEW QUESTIONS

1. Define diploid and haploid.
2. What stages of the human life cycle are diploid? Haploid?
3. Define fertilization, zygote, embryo, and fetus.
4. Be able to give the function of the male and female reproductive structures. Male: testis, epididymis, ductus deferens, seminal vesicles, prostate gland, bulbourethral gland, penis. Female: ovary, follicle, corpus luteum, fallopian tube (oviduct), uterus, cervix, vagina.
5. Is the male reproductive system completely separate from the urinary system? In females? Explain.
6. What are cleavage stages? Where in the female reproductive system does this normally occur?
7. What is a blastocyst? Which part develops into the embryo? The chorion?
8. Know the fates of the three germ layers: endoderm, mesoderm, and ectoderm.
9. Name the four extraembryonic membranes that support the fetus. What are the functions of each of the membranes?
10. Summarize the development of the neural tube.
11. Summarize the development of the respiratory system.
12. What is the branchial apparatus? Define branchial arch, pouch, and groove.
13. Describe the development of head and neck structures from the branchial apparatus. (Know Tables 1 and 2).
14. What is the critical period for palate development when major congenital defects occur? Functional defects?
15. What is the critical period for CNS development when major congenital defects occur? Functional defects?
16. Be able to give the major events of development that occur in each month of pregnancy.
17. Define: otic pit, optic sulcus, olfactory pit, somites, lanugo, vernix caseosa, brown fat, teratogens.