

Embryology

- **Embryology** – study of the origin and development of single individual
- Prenatal period
 - **Embryonic** period – first 8 weeks
 - **Fetal** period – remaining 30 weeks

The Embryonic Period

- Week 1 – from zygote to blastocyst
 - **Conception** – in lateral third of uterine tube
 - **Zygote** (fertilized oocyte) moves toward the uterus
 - **Blastomeres** – daughter cells formed from zygote
 - **Morula** – cluster of 12–16 blastomeres
 - **Blastocyst** – fluid-filled structure – about 60 cells

Fertilization and the Events of the First 6 Days of Development

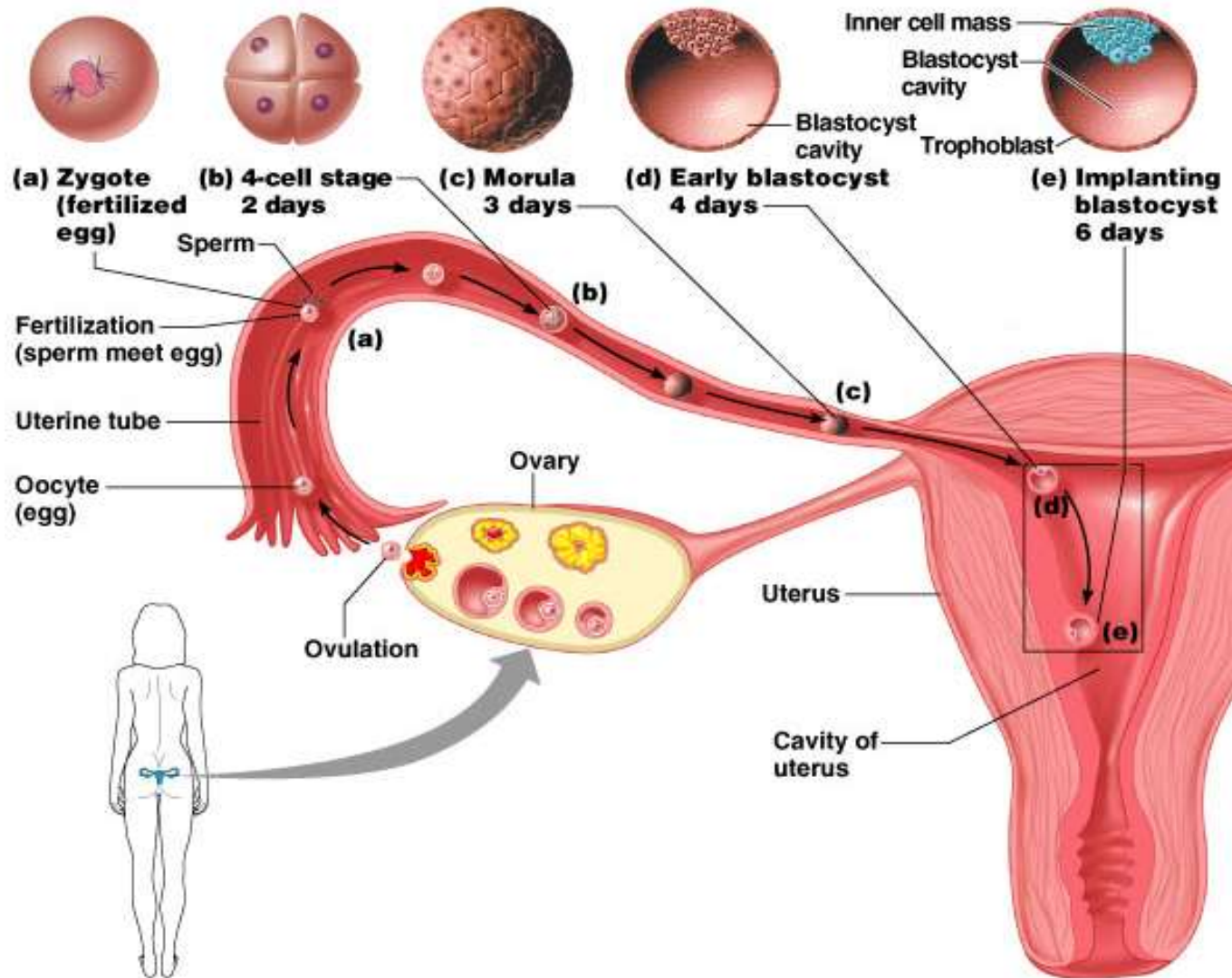


Figure 3.3

Week 2 – The Two-Layered Embryo

- Bilaminar embryonic disc – inner cell mass divided into two sheets
 - **Epiblast** and the **hypoblast**
 - Together make up the **bilaminar** embryonic disc

QuickTime™ and a
TIFF (LZW) decompressor
are needed to see this picture.

Week 2 – The Two-Layered Embryo

- Amniotic sac – formed by an extension of epiblast
 - Outer membrane – forms the **amnion**
 - Inner membrane – forms the **amniotic sac cavity**
 - Filled with amniotic fluid

Week 2 – The Two-Layered Embryo

- **Yolk sac** – formed by an extension of **hypoblast**
 - Digestive tube forms from yolk sac
 - Tissues around yolk sac
 - Gives rise to earliest blood cells and blood vessels

Implantation of the Blastocyst

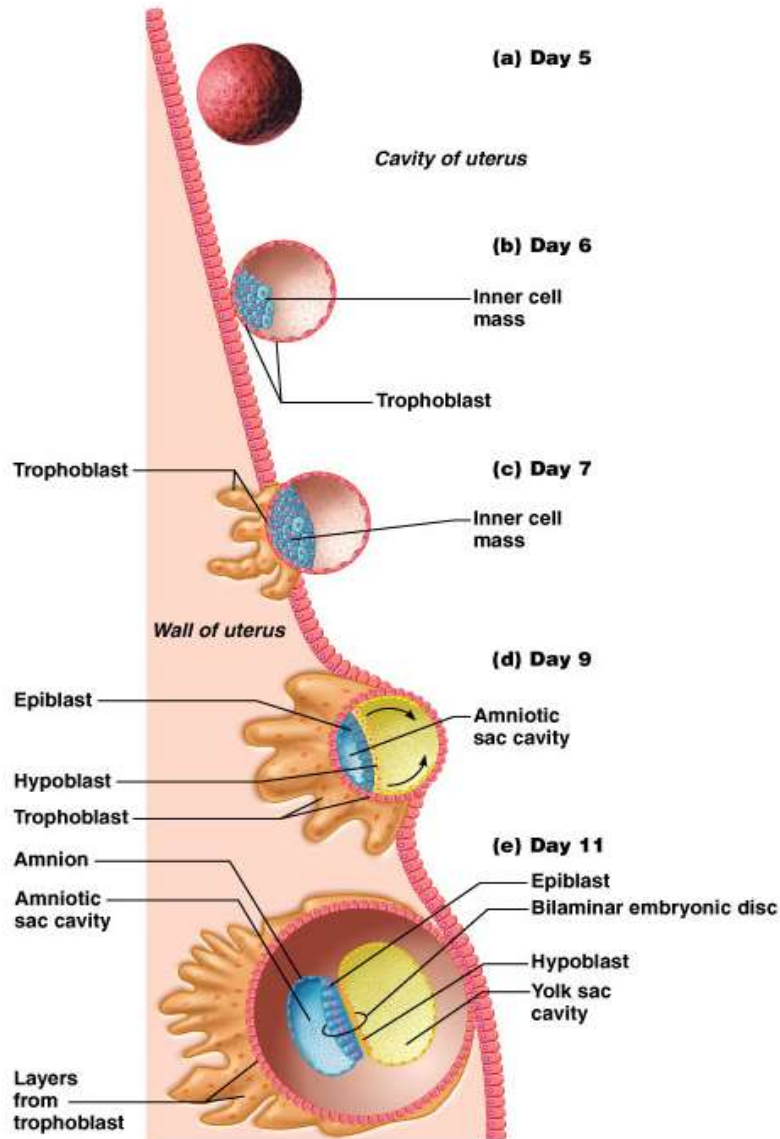


Figure 3.4

Week 3 – The Three-Layered Embryo

- **Primitive streak** – raised groove on the dorsal surface of the epiblast
- **Gastrulation** – a process of invagination of epiblast cells
- **Endoderm** – formed from migrating cells that replace the hypoblast
- **Mesoderm** – formed between epiblast and endoderm
- **Ectoderm** – formed from epiblast cells that stay on dorsal surface

The Primitive Streak

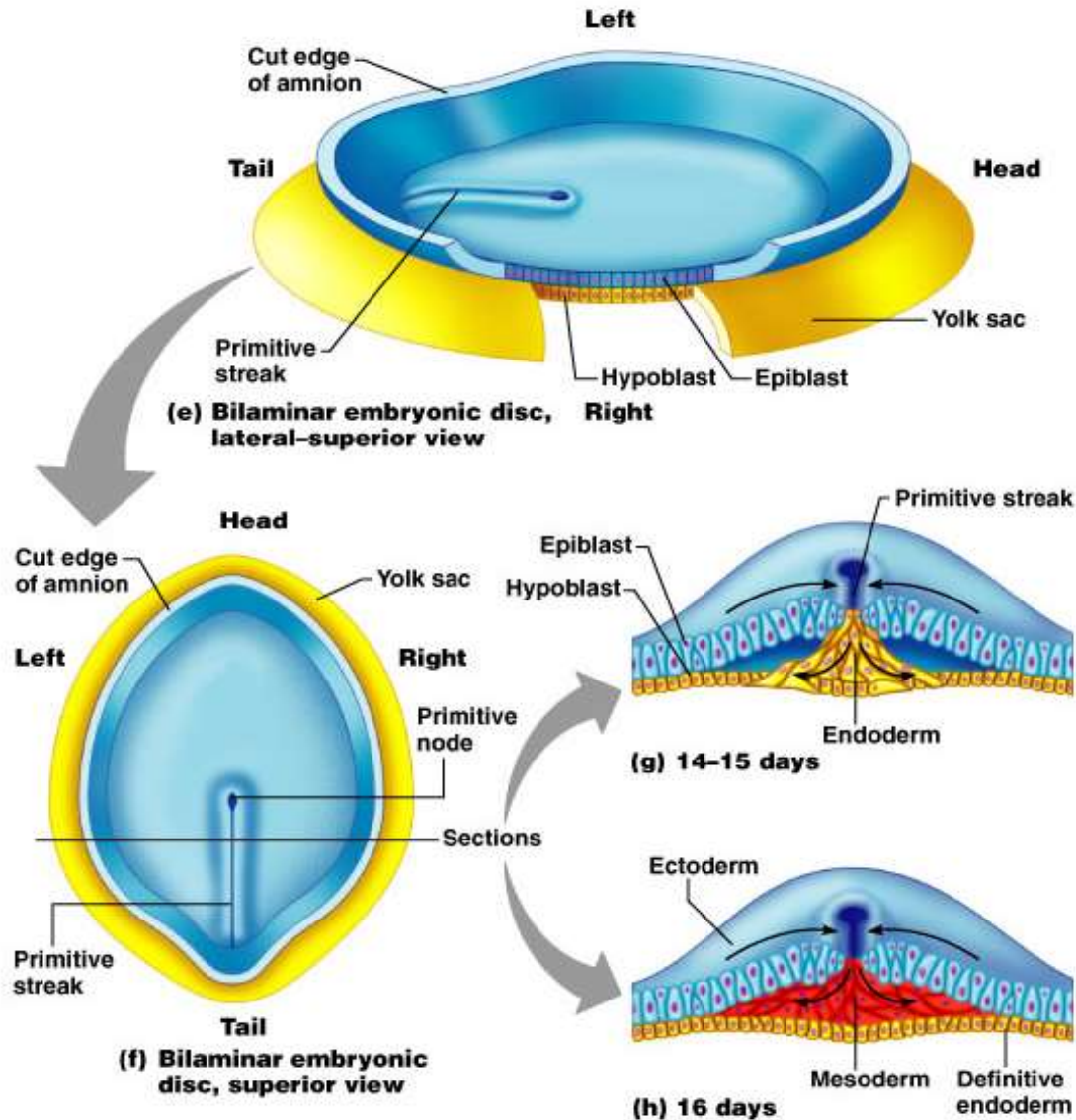


Figure 3.5e-h

The Notochord

- Primitive node – a swelling at one end of primitive streak
- Notochord – defines body axis
 - Is the site of the future vertebral column

Formation of the Mesoderm and Notochord

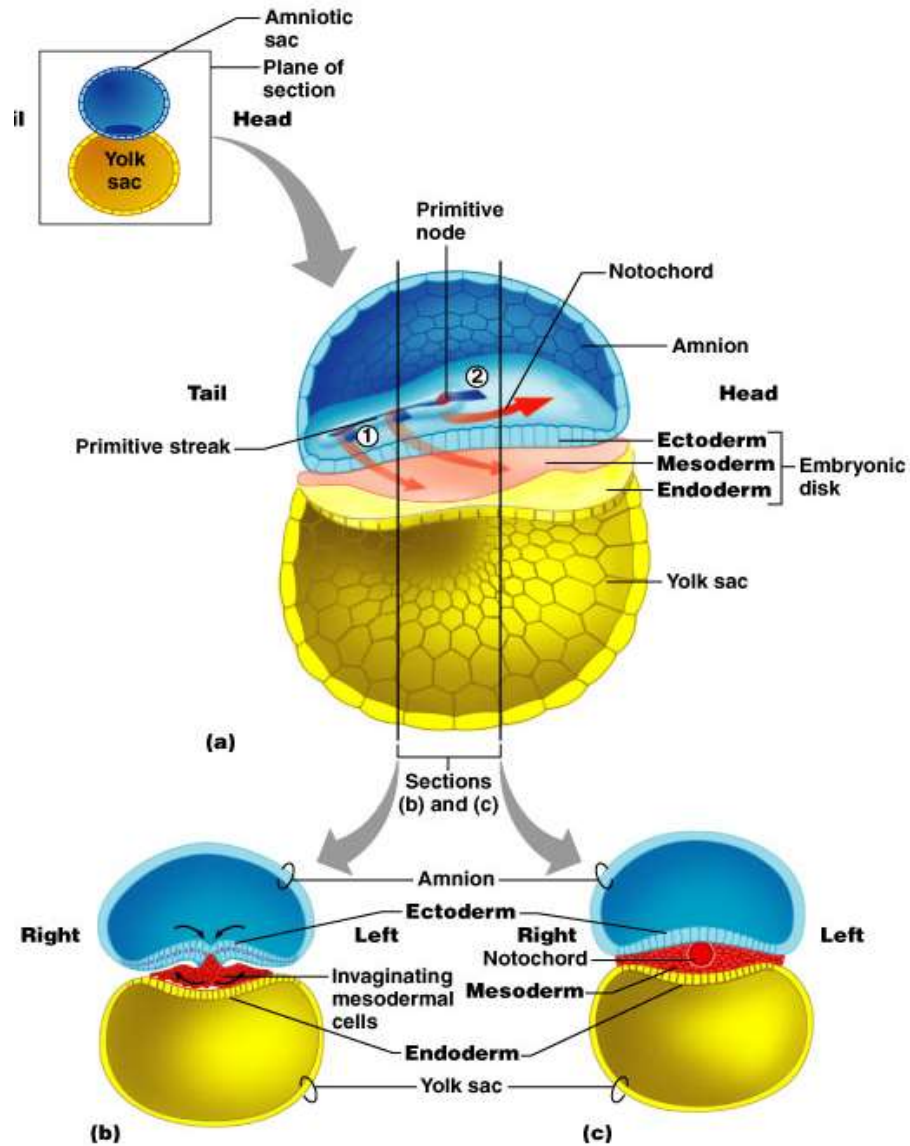


Figure 3.6

Neurulation

- Neurulation – **ectoderm** starts forming brain and spinal cord
 - Neural plate – ectoderm in the dorsal midline thickens
 - Neural groove – ectoderm folds inward
 - Neural tube – a hollow tube pinches off into the body
 - Cranial part of the neural tube becomes the brain
- Neural crest – forms sensory nerve cells, ganglia, and melanocytes

Changes in the Embryo

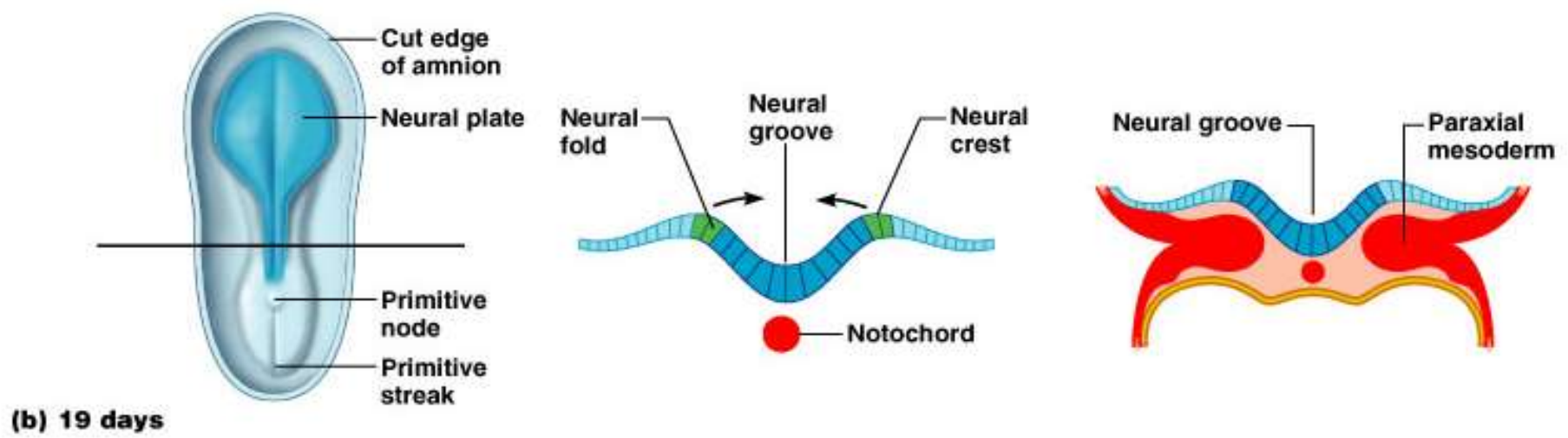
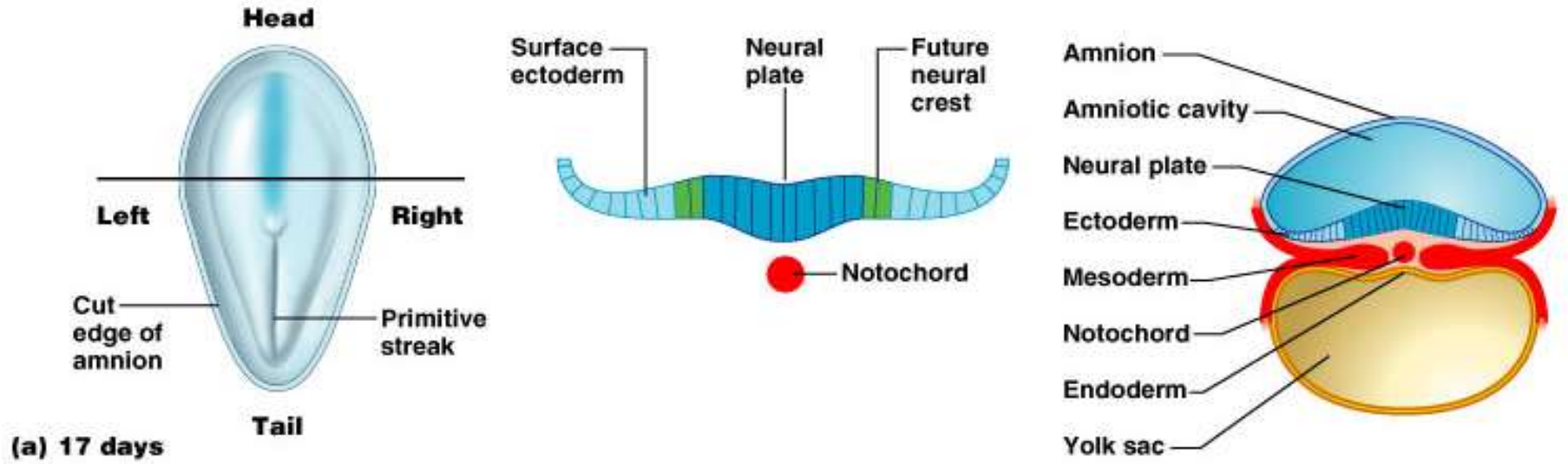
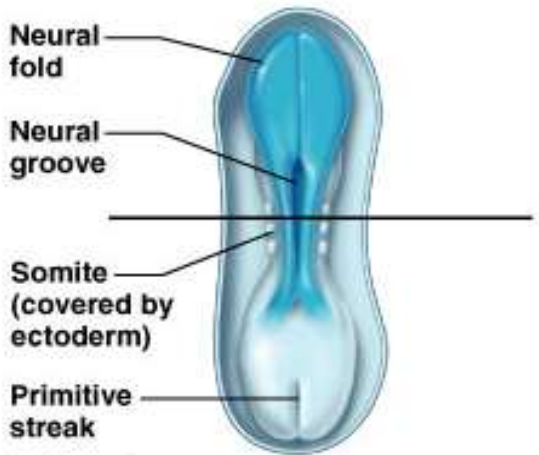
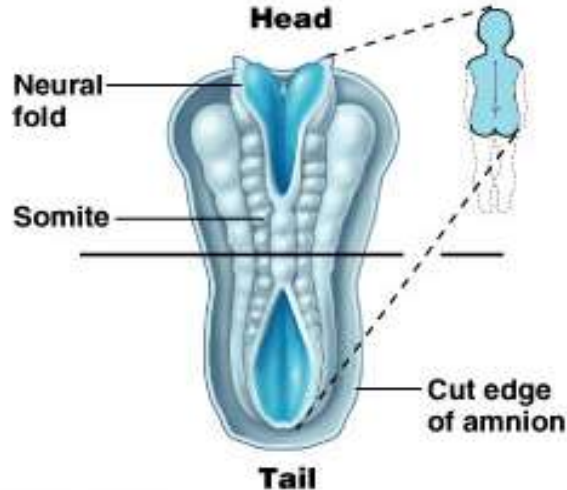
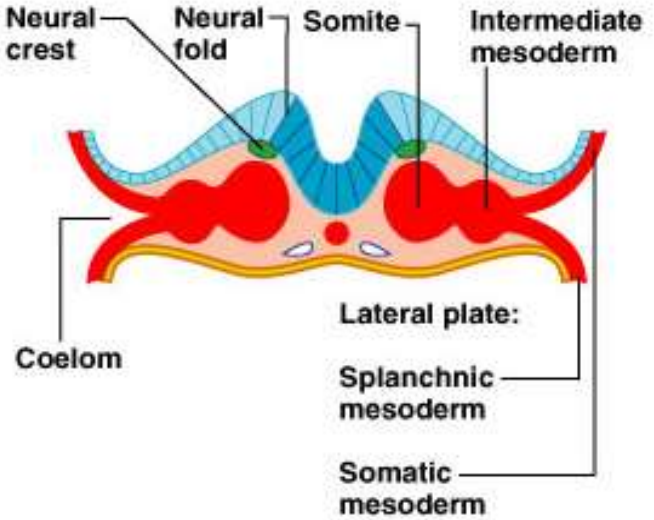
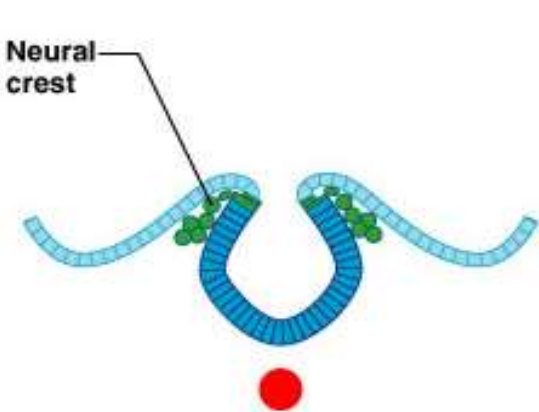


Figure 3.7a, b

Changes in the Embryo



(c) 20 days



(d) 22 days

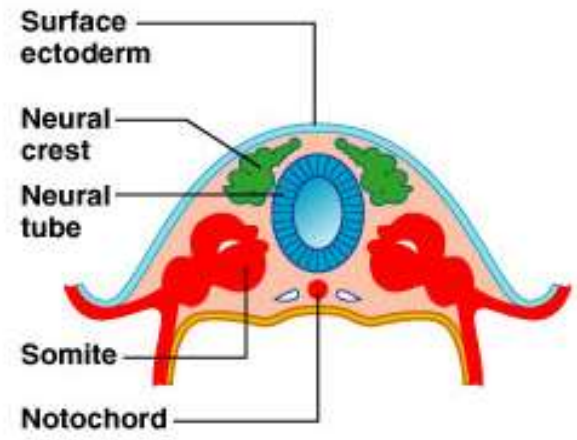
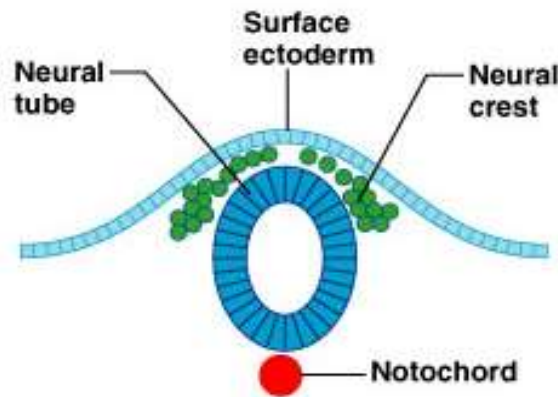


Figure 3.7c, d

The Germ Layers in Week Four

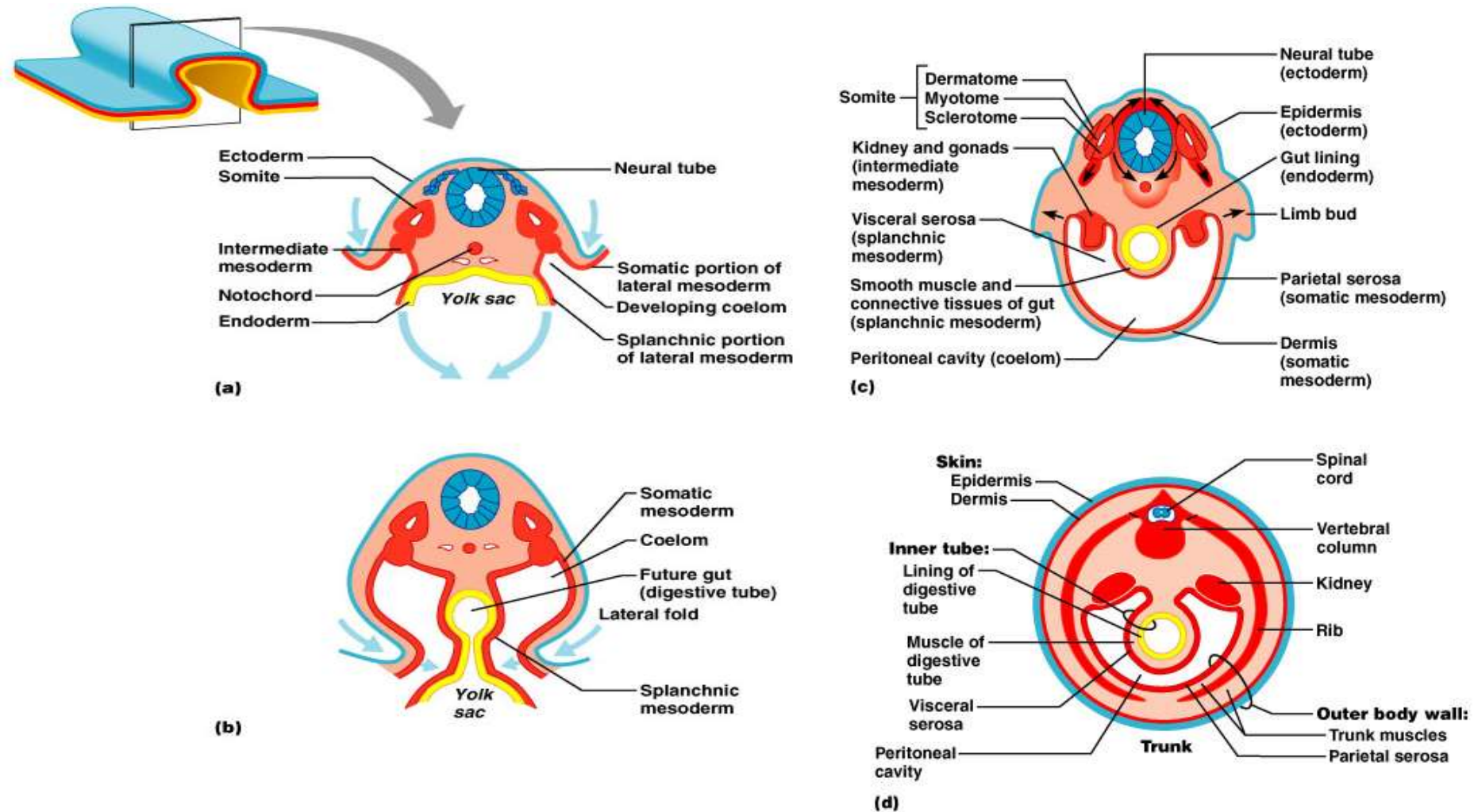


Figure 3.9a-d

Week 4 – The Body Takes Shape

- Derivatives of the germ layers
 - **Ectoderm** – forms brain, spinal cord, and epidermis
 - **Endoderm**
 - Forms inner epithelial lining of the gut tube
 - Forms respiratory tubes, digestive organs, and urinary bladder

Week 4 – The Body Takes Shape

- **Notochord** – gives rise to nucleus pulposus within intervertebral discs
- **Mesoderm** – forms muscle, bone, dermis, and connective tissues
 - *Somites* divides into **sclerotome (vertebrae and ribs)**, **dermatome (dermis of skin in dorsal part of body)**, and **myotome (trunk and limb muscles)**
 - *Intermediate mesoderm* – forms kidneys and gonads
 - (SEE FIGURE 3.10, PG 60)

Week 4 – The Body Takes Shape

- **Mesoderm**
 - **Splanchnic mesoderm**
 - Forms musculature, connective tissues, and serosa of the digestive and respiratory structures
 - Forms heart and most blood vessels
 - **Somatic mesoderm** – forms dermis of skin, bones, and ligaments

Week 5-8 – The Second Month of Embryonic Development

- Limb buds form
- Embryo first looks recognizably human
- Head is disproportionately large
- All major organs are in place

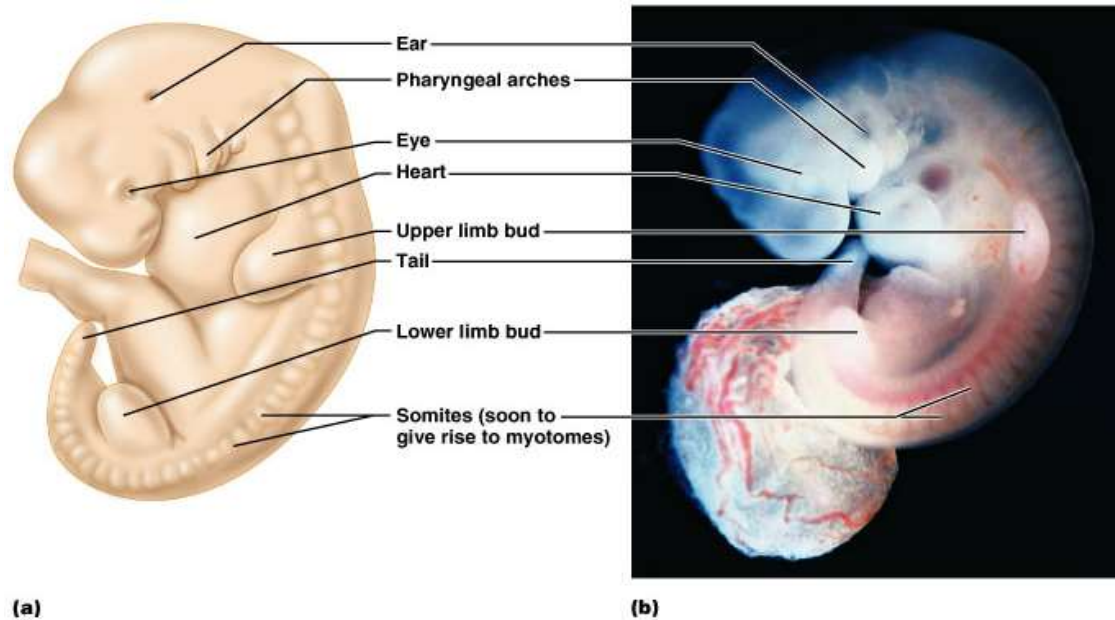



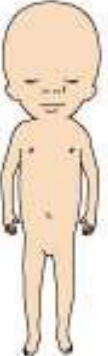
Figure 3.11

The Fetal Period

- A time of maturation and rapid growth
- Cells are differentiating during the first half of the fetal period
- Normal births occur 38 weeks after conception
- Premature birth is one that occurs before 38 weeks


Developmental Events of the Fetal Period

Table 3.1 Developmental Events of the Fetal Period (1 of 3)

Time after fertilization	Events
8 weeks (end of embryonic period)	<p>Eyes and ears first look human; neck region first becomes evident</p> <p>Head is nearly as large as rest of body; all major divisions of the brain are present; first brain waves occur in brain stem</p> <p>Liver is disproportionately large</p> <p>Bone formation has just begun; weak muscle contractions occur</p> <p>Limbs are complete; digits are initially webbed, but fingers and toes are free by end of week 8</p> <p>The cardiovascular system is fully functional; the heart has been pumping blood since week 4</p> <p>Approximate crown-to-rump length: 3 cm (1.2 inches); weight: 2 g (0.06 ounce)</p>
8 weeks	
9–12 weeks (month 3)	<p>Head is still dominant, but body is elongating; brain continues to enlarge; retina of eye is present</p> <p>Skin epidermis and dermis are differentiated</p> <p>Liver is still prominent; right and left halves of palate (roof of mouth) are fusing; walls of hollow visceral organs are gaining smooth muscle</p> <p>Blood cell formation begins in bone marrow (also occurs in liver and spleen)</p> <p>Notochord is degenerating and bone formation is accelerating</p> <p>Sex can be determined from the genitals</p> <p>Approximate crown-to-rump length at end of 12 weeks: 9 cm</p>
12 weeks	

Developmental Events of the Fetal Period

Table 3.1 Developmental Events of the Fetal Period (2 of 3)

Time after fertilization	Events	
13–16 weeks (month 4)	<p data-bbox="801 432 1860 504">Sucking motions of the lips occur, and eyes can flinch if stimulated (but eyes are closed, not open)</p> <p data-bbox="801 515 1860 554">Body begins to outgrow head; limbs are no longer so disproportionately small</p> <p data-bbox="801 565 1083 604">Hard palate is fused</p> <p data-bbox="801 615 1319 654">Kidneys attain their typical structure</p> <p data-bbox="801 665 1649 704">Most bones are now distinct, and joint cavities are apparent</p> <p data-bbox="801 715 1678 753">Approximate crown-to-rump length at end of 16 weeks: 14 cm</p>	
16 weeks		<p data-bbox="801 786 1860 858">Eyelashes and eyebrows are present; a fatty skin secretion covers the body; silk-like hair, called lanugo, covers the skin</p> <p data-bbox="801 869 1456 908">Quickening occurs (mother feels fetus moving)</p> <p data-bbox="801 919 1715 991">Body first bends forward into the fetal position because of space restrictions in the uterus</p> <p data-bbox="801 1002 1315 1041">Limbs achieve near-final proportions</p> <p data-bbox="801 1052 1678 1090">Approximate crown-to-rump length at end of 20 weeks: 19 cm</p>
17–20 weeks (month 5)		

Developmental Events of the Fetal Period

Table 3.1 Developmental Events of the Fetal Period (3 of 3)

Time after fertilization	Events
21–30 weeks (months 6 and 7)	<p>Body size and weight substantially increase</p> <p>Eyes open</p> <p>Fingernails and toenails are complete</p> <p>Skin is wrinkled and red; the fatty layer under the skin (hypodermis) is just starting to gain fat, so body is lean</p> <p>Bone marrow becomes the only site of blood cell formation</p> <p>Testes reach the scrotum in month 7 (males)</p> <p>Approximate crown-to-rump length at end of 30 weeks: 28 cm</p>
30–38 weeks (months 8 and 9)	<p>Fat accumulates in hypodermis below skin</p> <p>Approximate crown-to-rump length at end of 38 weeks: 36 cm; weight 2.7–4.1 kg (6–10 pounds)</p>



At birth