

# **Basic Embryology**

# Development & Embryology

- Development:
  - The continual modification of structures from conception to maturity due to the growth, differentiation and reorganization of cells
  - Developmental Stages:
    - Prenatal – development from conception to birth
    - Postnatal – development from birth through maturity
- What is embryology?
  - The study of developmental events that occur during the prenatal stage
- Why study embryology?
  - To gain an understanding of where and how the anatomical structures came to be

# Embryology

- Embryonic period vs. Fetal period
  - Embryonic – first 8 weeks
    - Development of the three primary germ layers give rise to all structures
    - Basic body plan takes shape
  - Fetal period – remaining 30 weeks
    - Structures and organs continue to grow and develop, increasing in complexity



6 weeks



9 weeks

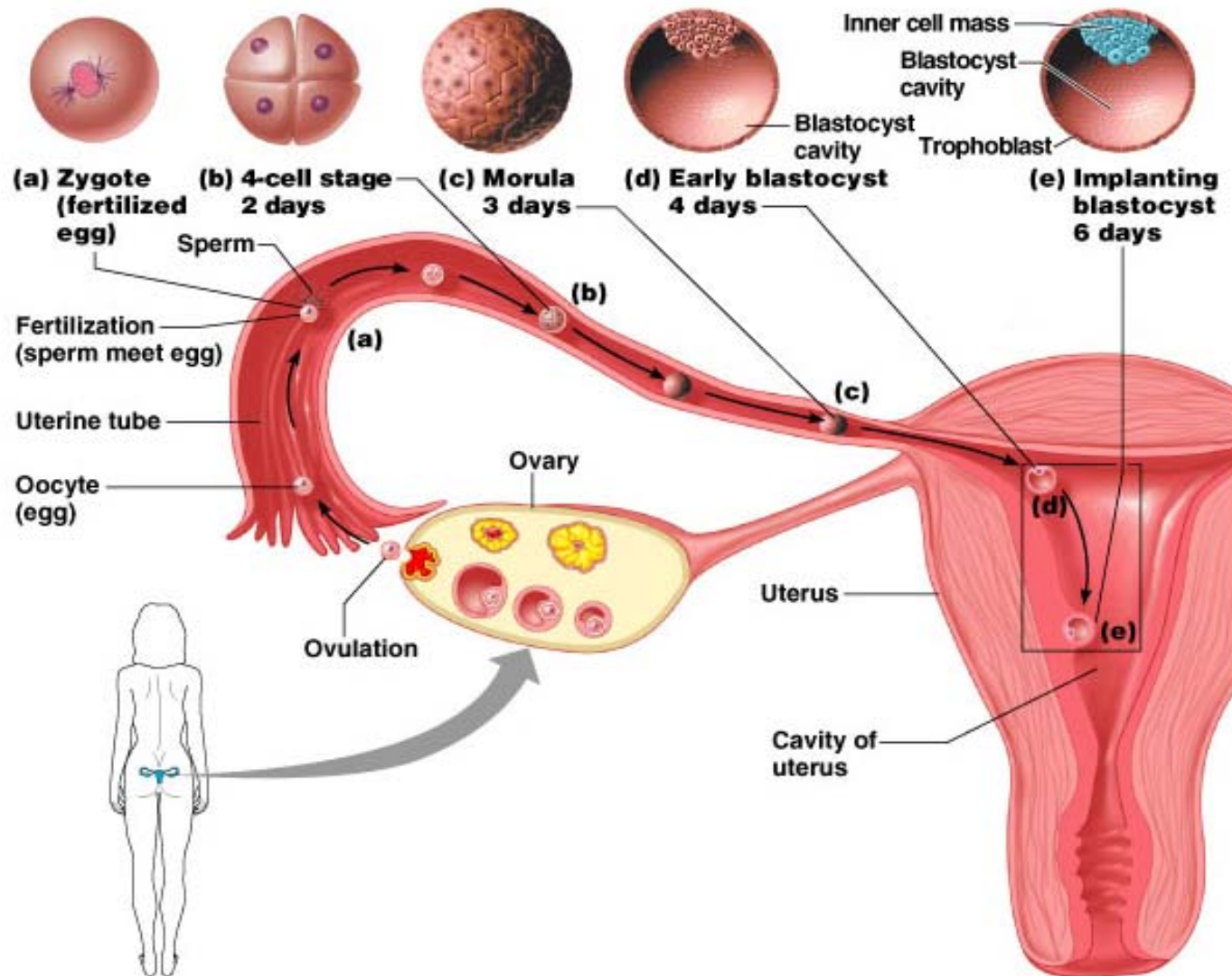


28 weeks

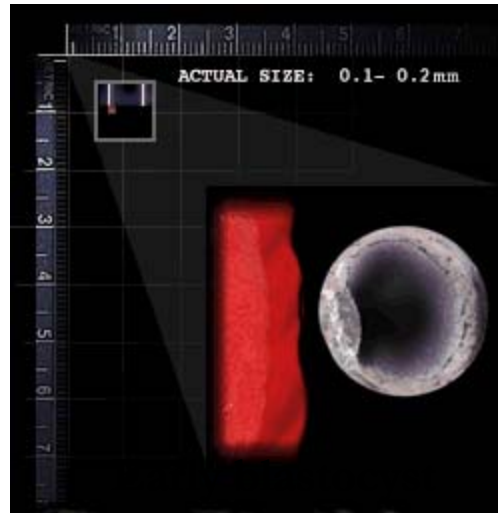
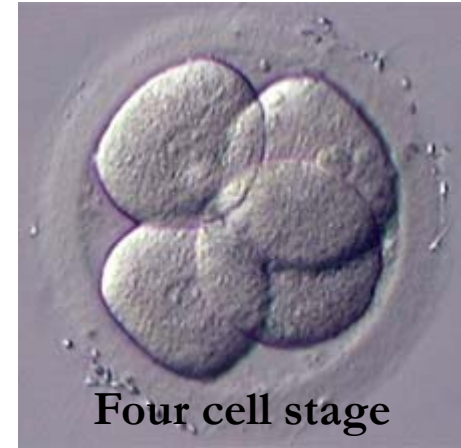
# The Embryonic Period

- Major Events of First Week
  - Conception – in lateral third of uterine tube
    - Fusion of female and male pronuclei = amphimixis
  - Zygote (46 chromosomes) moves toward the uterus
  - Blastomeres – daughter cells formed from zygote
  - Morula (means mulberry) – cluster of 12–16 blastomeres
  - Blastocyst – blastomeres form hollow sphere– about 60 cells
    - Inner cavity is called the blastocoele
    - Trophoblast – layer separating blastocoele from external environment

# Fertilization and the Events of the First 6 Days of Development

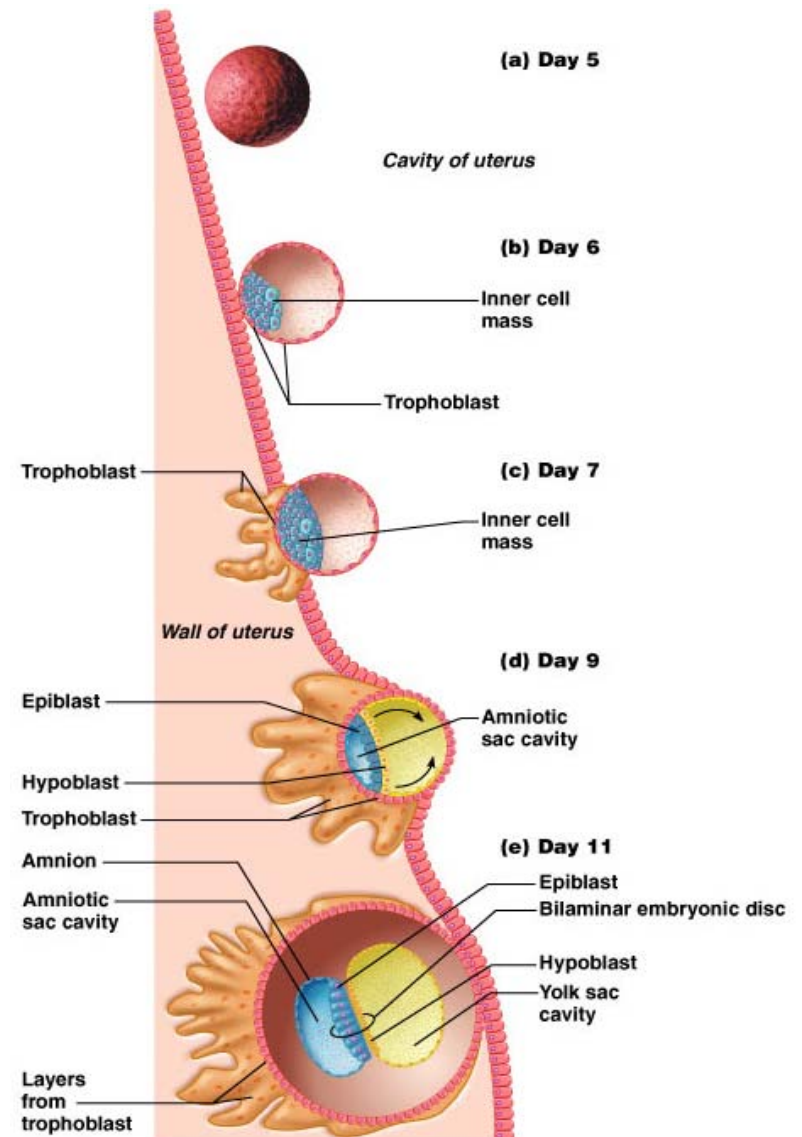


# First week Pictures



# Implantation

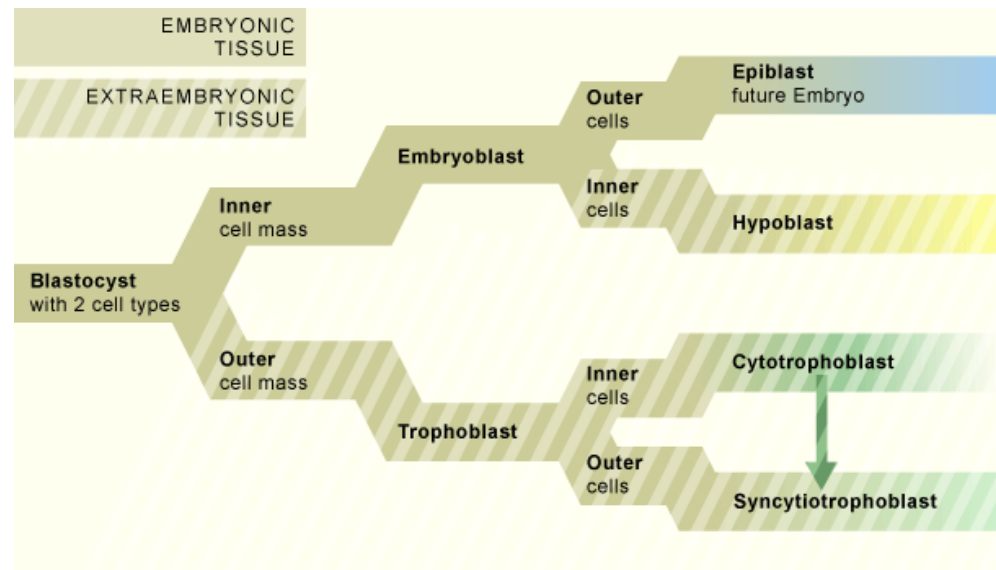
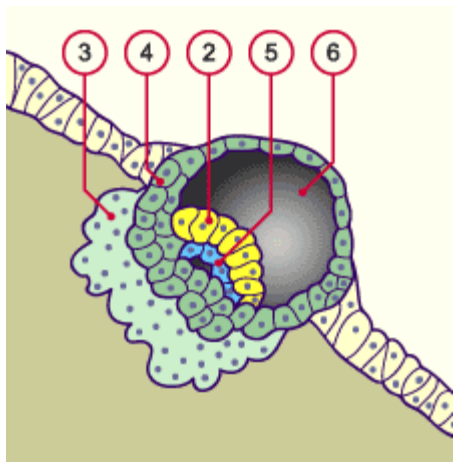
- When:
  - Occurs during weeks 1 & 2
- Where:
  - Endometrium of uterine wall
- Why:
  - To further support, nourish (with developing vascularity) and protect embryo
- How:
  - When contact occurs, the trophoblast divides rapidly, creating a multinucleated mass called the syncytial trophoblast
  - This syncytial trophoblast secretes enzymes allowing the blastocyst to penetrate





# Week 2 – The Two-Layered Embryo (Blastodisc)

- Bilaminar embryonic disc formed when the inner cell mass divide and forms into two sheets
  - Epiblast (5) and the hypoblast (2)
    - Together make up the bilaminar embryonic disc or blastodisc





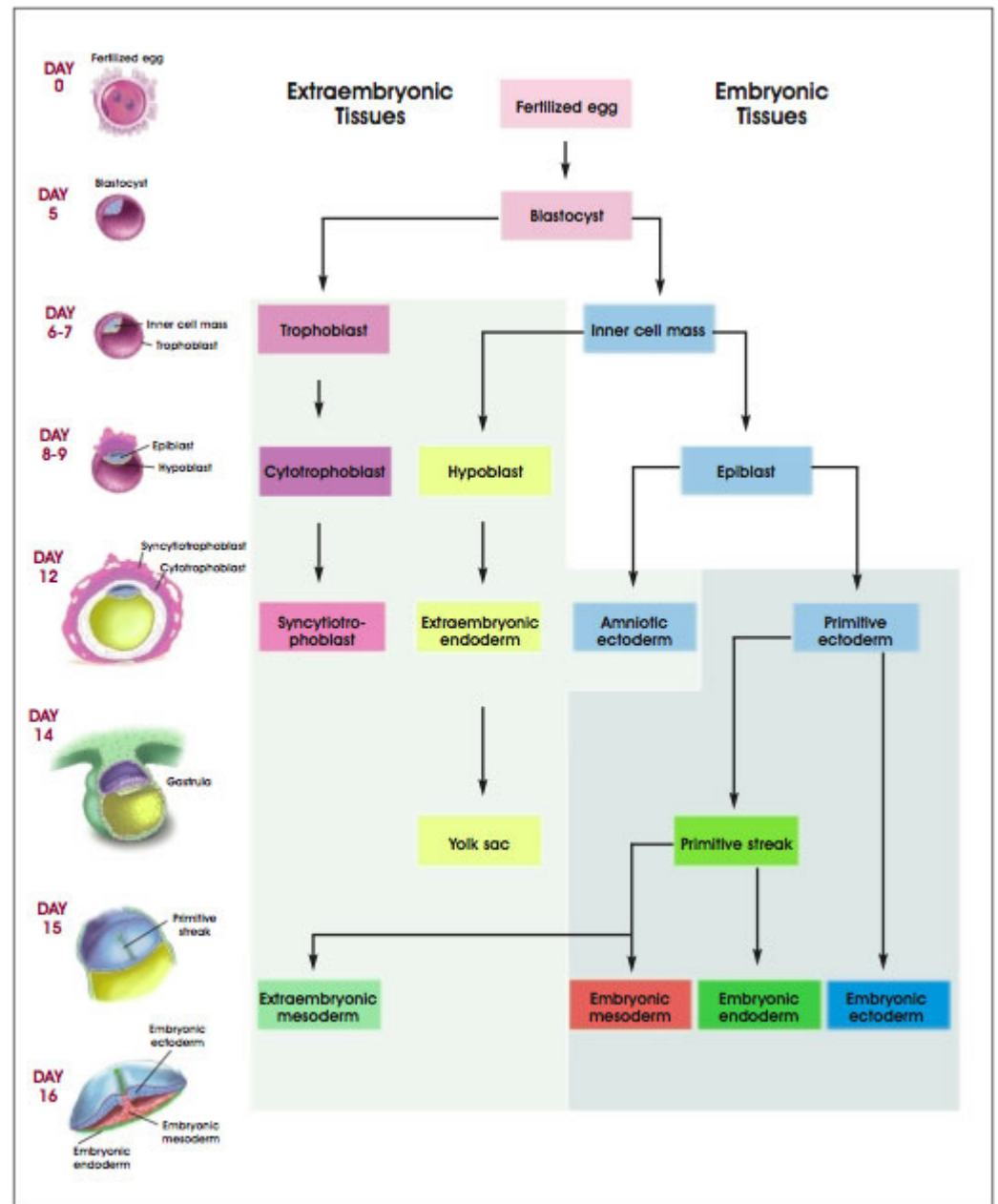
# Week 2 – Blastodisc

- Amniotic sac – formed by an extension of epiblast as the cells divide
  - Inner membrane – forms the **amniotic sac cavity** (in conjunction with the outer membrane)
    - Filled with amniotic fluid
  - Outer membrane (future mesoderm) – forms the **amnion**
- Yolk sac – formed by an extension of hypoblast
  - Digestive tube forms from yolk sac
  - Tissues (future mesoderm) around yolk sac gives rise to earliest blood cells and blood vessels

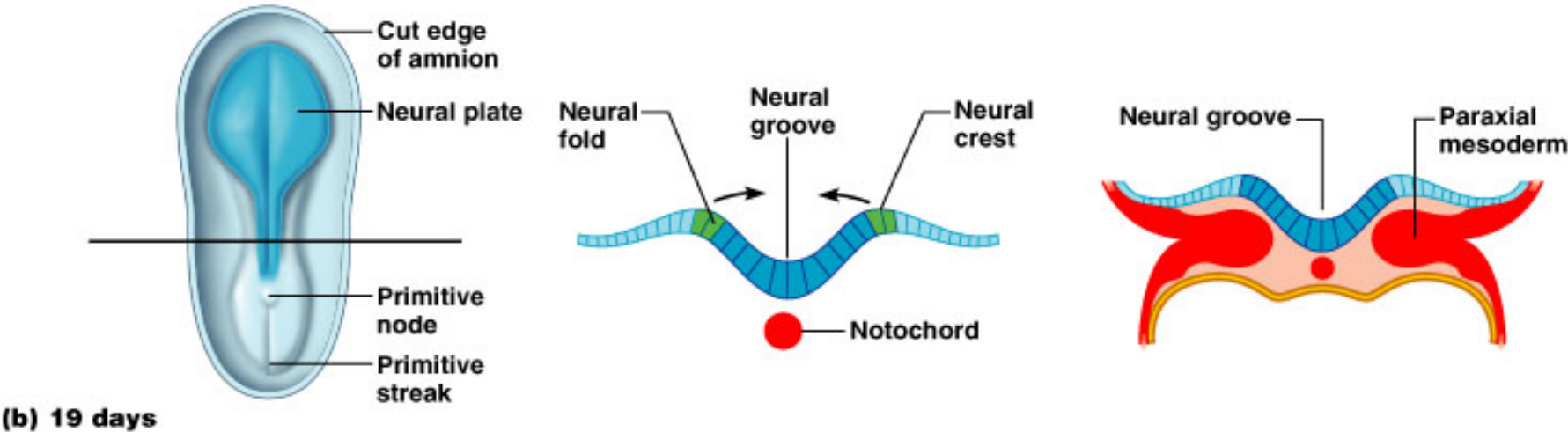
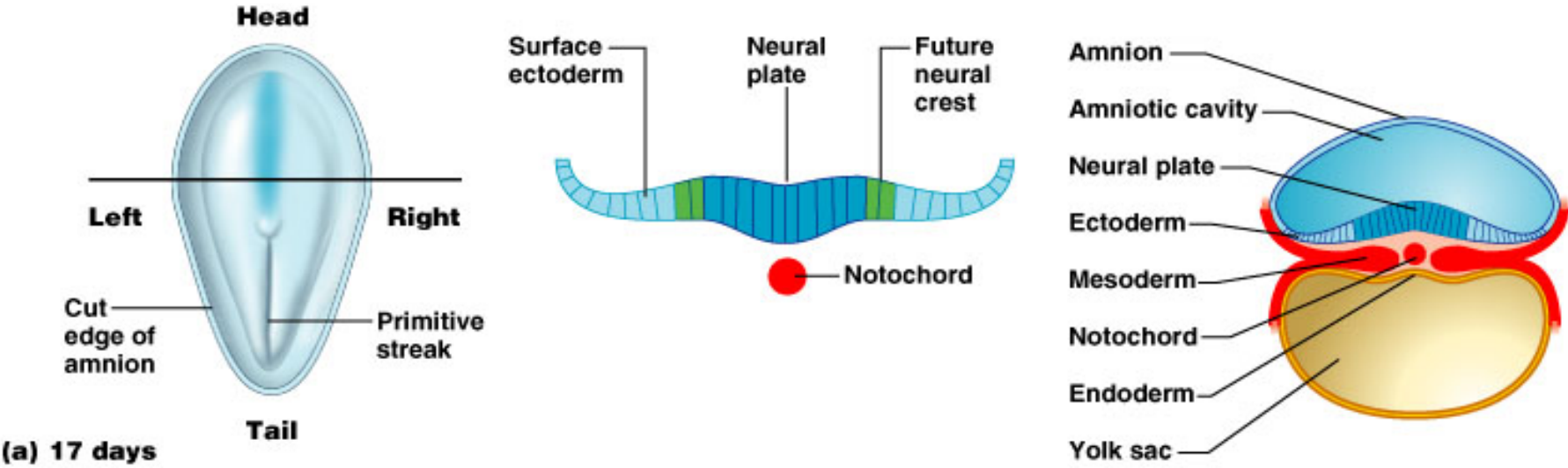
# Week 3 –Three-Layered Embryo

- Primitive streak – raised groove on the dorsal surface of the epiblast
- Gastrulation – a process of invagination of epiblast cells. A very incredibly important step in development as this process forms the
  - Endoderm – formed from migrating cells that replace the hypoblast
  - Mesoderm – formed between epiblast and endoderm, these cells divide and spread and form parts of the amnion and yolk sac.
  - Ectoderm – formed from epiblast cells that stay on dorsal surface

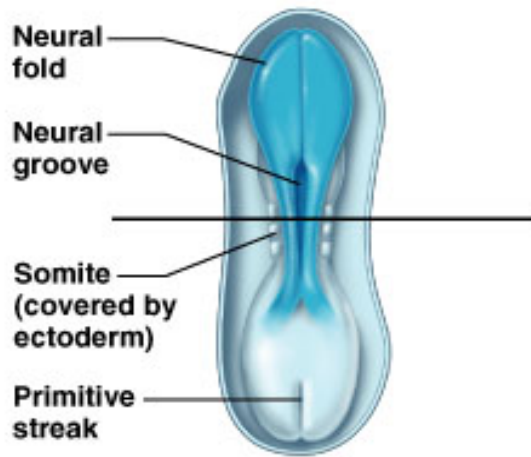
- Developmental “time line” of the three primary germ layers



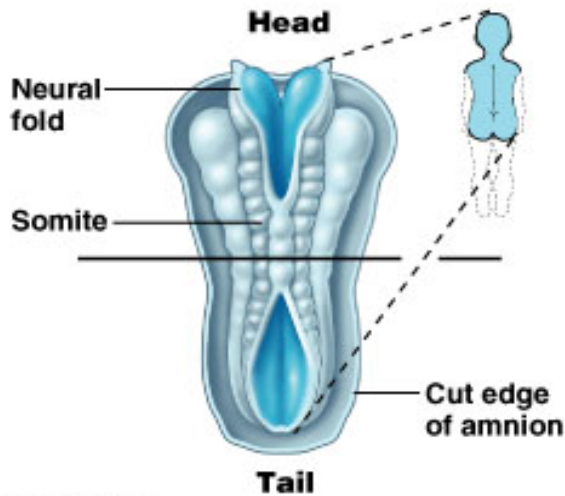
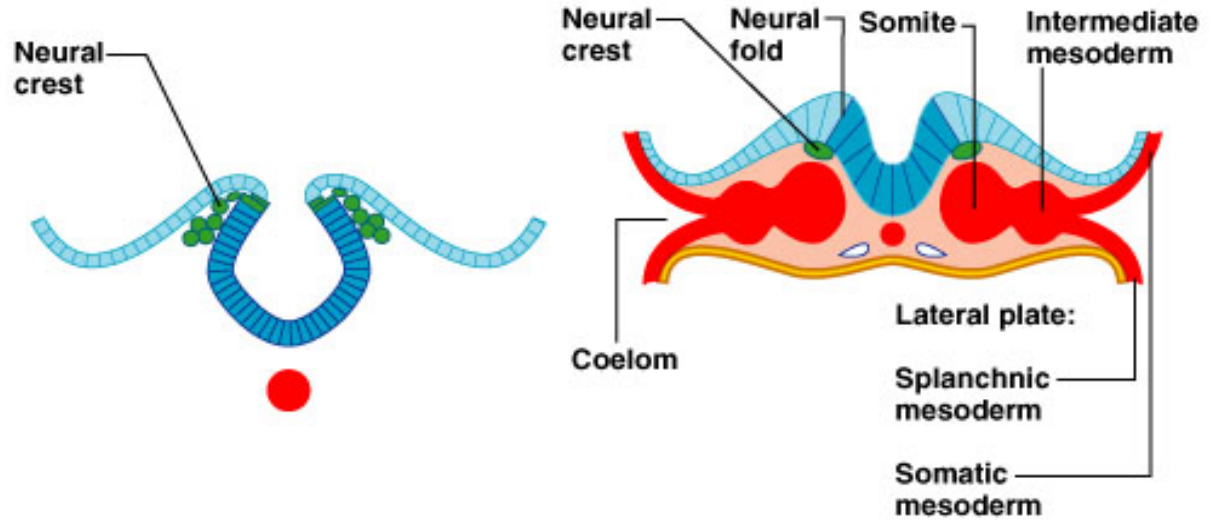
# Following the Germ Layers and changes in the Embryo



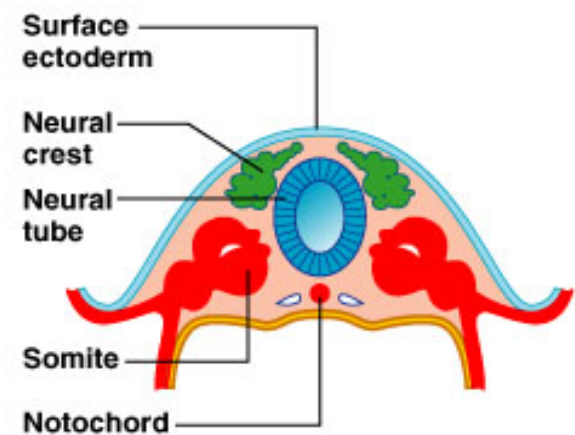
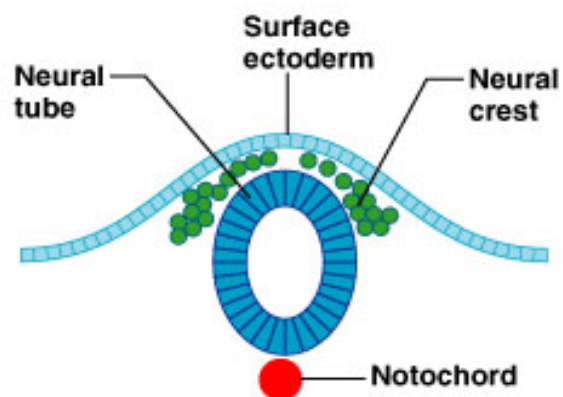
# Following the Germ Layers and changes in the Embryo



(c) 20 days

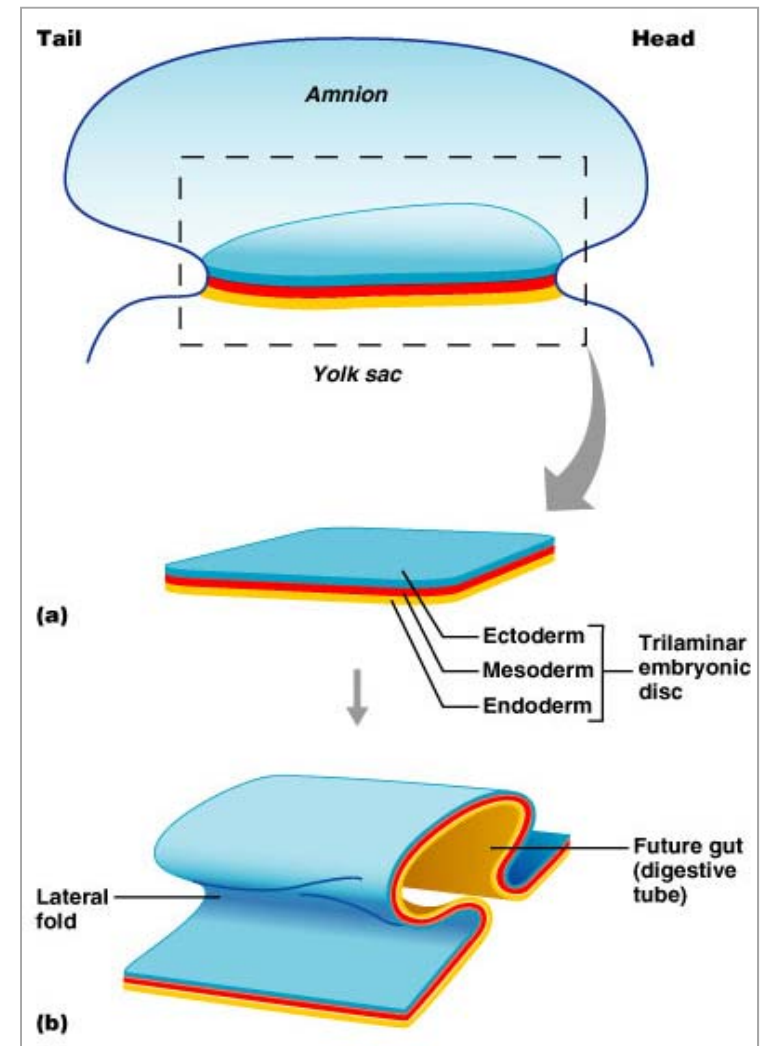
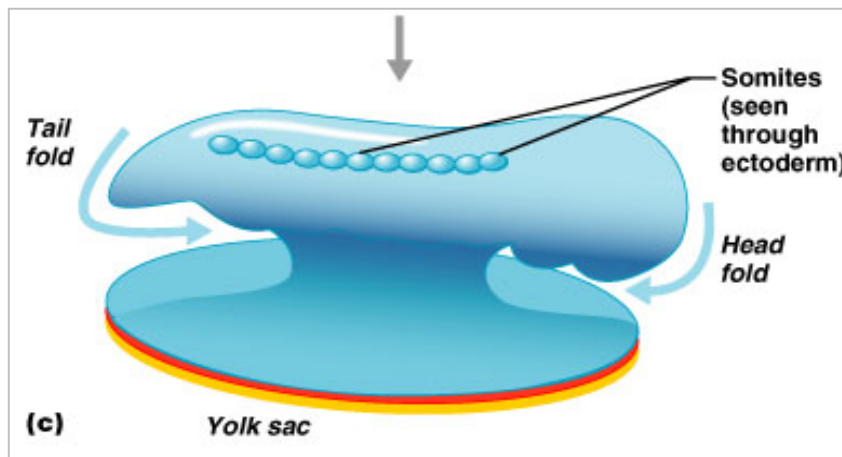


(d) 22 days



# Week 4 – The Body Takes Shape

- Folding of embryo laterally and at the head and tail
  - Primitive gut – formed by lateral folding
  - "Tadpole shape" by day 24



# Germ Layer Destinations

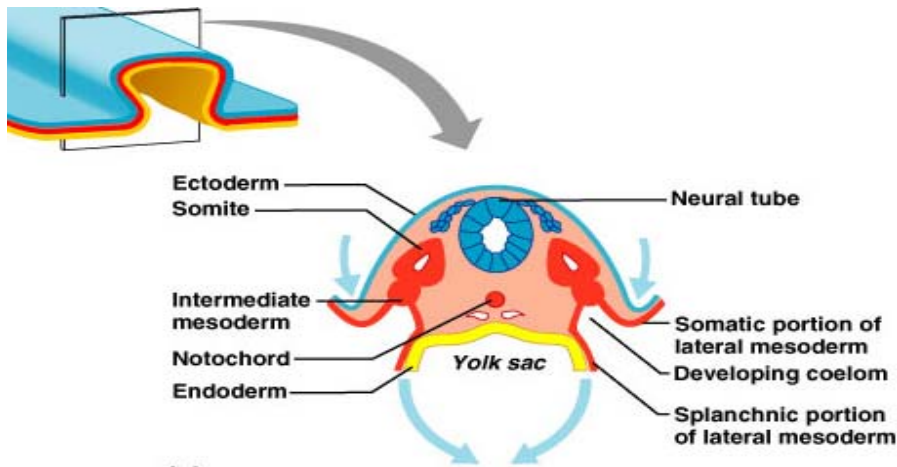
- Ectoderm – forms brain, spinal cord, and epidermis
- Endoderm
  - Forms inner epithelial lining of the gut tube
  - Forms respiratory tubes, digestive organs, and urinary bladder



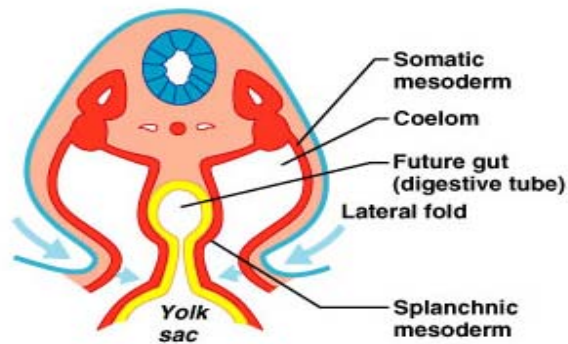
# Germ Layer Destinations cont...

- Mesoderm – forms muscle, bone, dermis, and connective tissues
  - Somites divides into sclerotome, dermatome, and myotome
  - Intermediate mesoderm – forms kidneys and gonads
  - 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

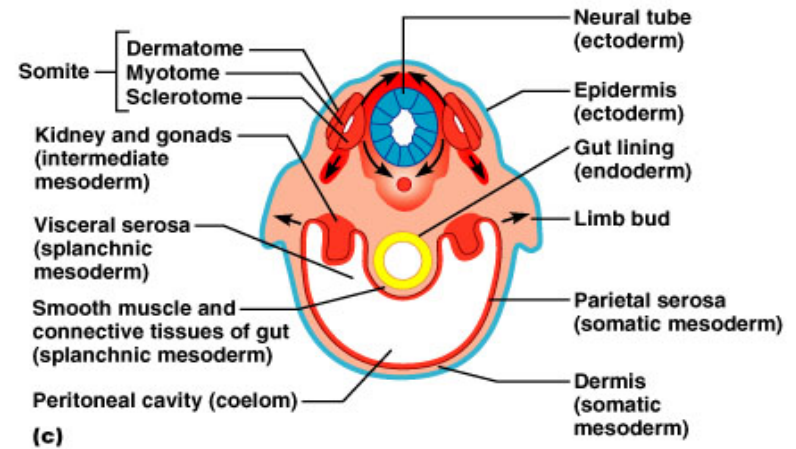
# The Germ Layers in Week Four



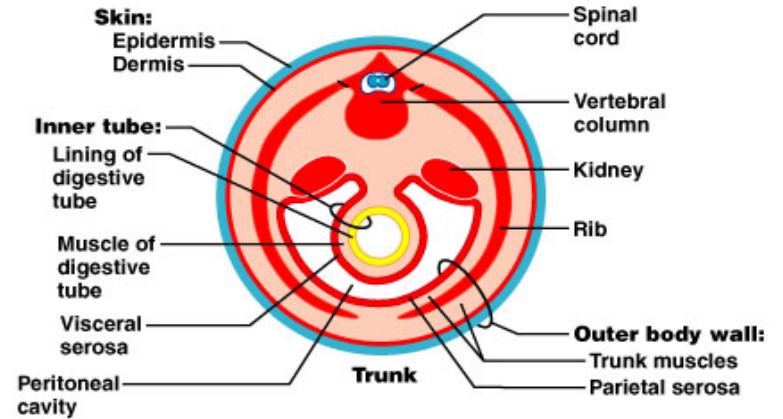
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(b)

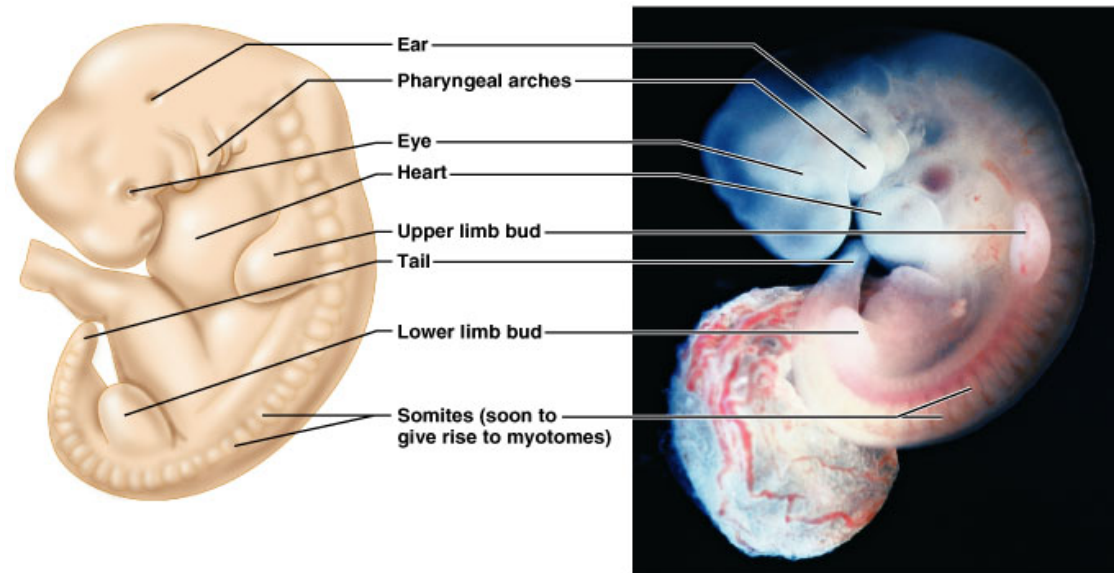


(c)



# 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



# Fetal Period Facts & Stats

- 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

8 weeks

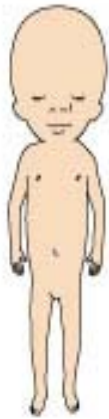


- Eyes & ears take on human form
- Neck becomes evident & head is almost as large as rest of body
- Liver is large in relation to size of body
- Bone formation begins as do weak muscle contractions
- Limbs are formed and digits are separated
- Cardiovascular system is functioning and heart is pumping (since week 4)
- Size: 3 cm (crown to rump)

# Developmental Events of the Fetal Period

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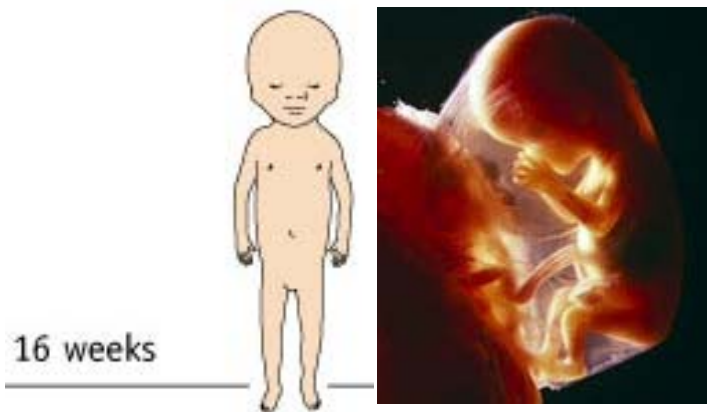
12 weeks



- Head is still large (body is elongating) & brain development continues and retina is formed
- Differentiation of epidermis & dermis occurs
- Liver is large, hard palate fusion starts, smooth muscle appears in hollow visceral organs
- Blood cells formation gets underway in bone marrow & spleen
- Notochord is being replaced by bone
- Gender determination is possible in ultrasound viewing
- Size: 9 cm (crown to rump)

# Developmental Events of the Fetal Period

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- Sucking actions occur & eye movement is seen (eyes still closed)
- Body starts to catch up to head size & limbs appear more proportionate
- Hard palate is fused
- Kidneys take on normal appearance
- Joint cavities present & most bones are distinct
- Size: 14 cm (crown to rump)

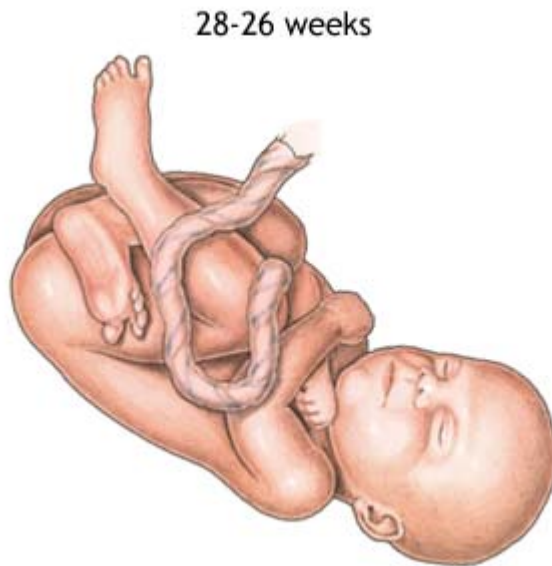


# Developmental Events of the Fetal Period



- Eyelashes & eyebrows present, fatty skin secretion covers the body, lanugo covers the skin
- Quickening occurs
- Fetal position is attained (due to space restrictions)
- Limbs reach normal proportions
- Size: 19 cm

# Developmental Events of the Fetal Period

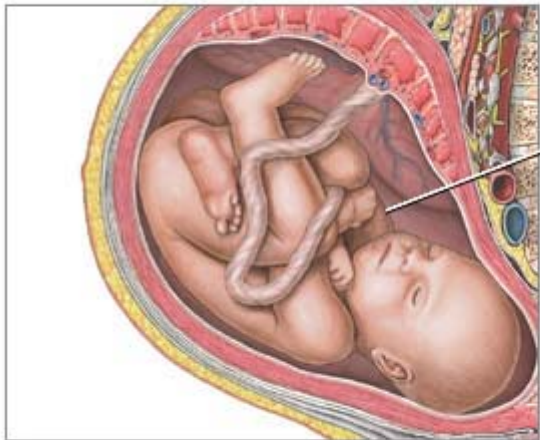


- Body size & weight increase
- Eyes open
- Fingernail & toenails are developed
- Skin is wrinkled & red, subcutaneous fat is just starting to accumulate
- Bone marrow becomes sole site for blood cell development
- Testes descend into scrotum
- Size: 28 cm

# Developmental Events of the Fetal Period

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- Fat accumulation occurs in subcutaneous layer
- Size: 36 cm
- Weight: 2.7 – 4.1 kg.



Normal fetus  
at 38th week  
of pregnancy

# Postnatal Development

- What are the events of postnatal development?
  - We will discuss some of this during system studies!