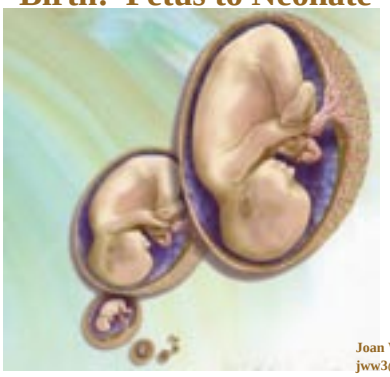
Birth: Fetus to Neonate



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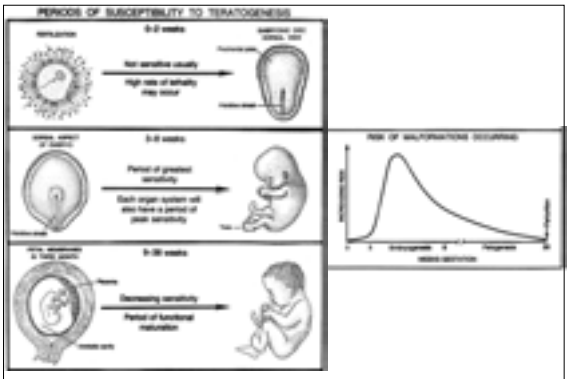
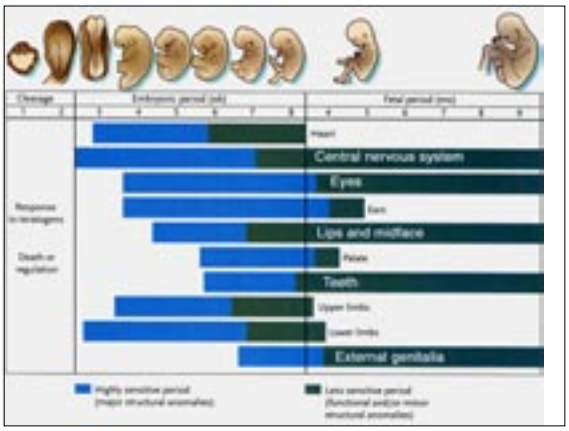
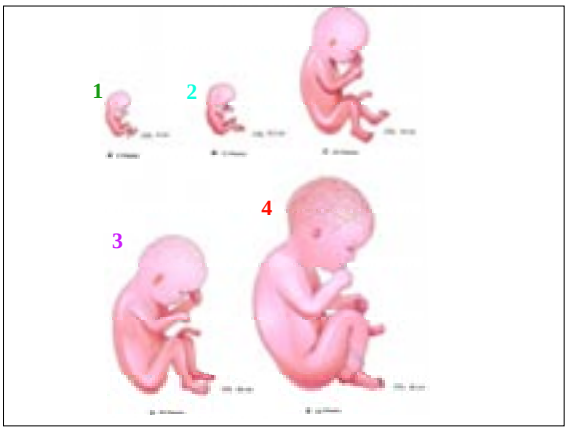




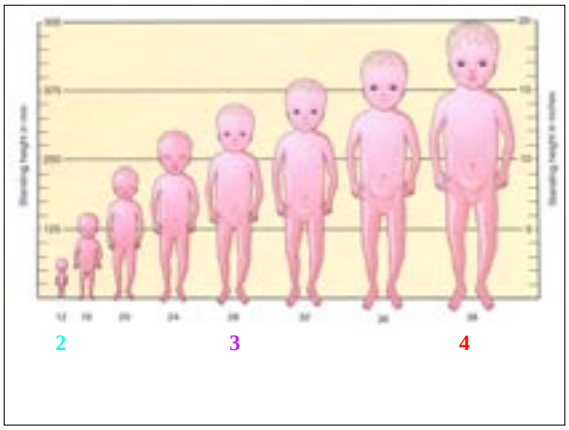


Maturation
9 wks, 12 wks, 28 wks, Term

- **Appearance**
- **Nervous system**
- **Movement and sensory response**
- **Gut, kidney, liver, hematopoiesis**
- **Endocrines**
- **Respiratory system**
- **Cardiovascular**

Beginning of fetal period
9 wks

- **Head half of crown rump length**
- **Eyelids unfused, external ear**
- **Nostrils with epithelial plugs**
- **All digits**
- **Tail disappearing**
- **Gut herniated into cord**
- **Indifferent external genitalia**



Early Fetus 9wks

- Gut recanalized
- Mesonephros regressing
- Hematopoiesis in liver
- Diaphragm, lung anlagen
- Heart partitioned
- Definitive aortic arches
- Ossification begun
- Startle response

Nervous System

Embryonic

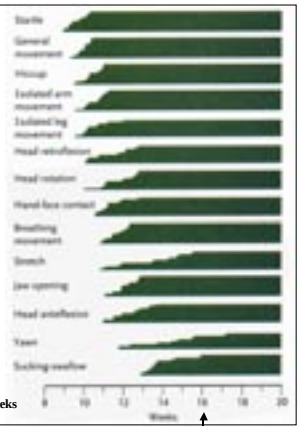
- Major brain divisions cranial nerves, motor, sensory, sympathetic parasympathetics

Fetal

- 10-11 wks: myelination begins in spinal roots and spinal cord
- 4 mos: myelination brain begins
- 6 mos: grooves, sulci, gyri
- At birth brain is 25% of adult volume, increase mainly due to myelination

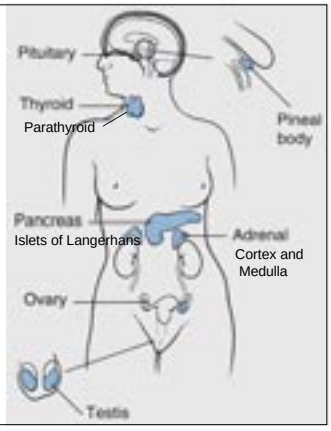
Ontogeny of fetal movements

- General movement, startle - early fetus
- Yawn, hiccup, swallow, gasp - early 2nd trimester
- Move eyes 4 mos
- Mother feels movement of fetus 4 mos
- Diurnal rhythms activity 5 mos
- Sucking - near term



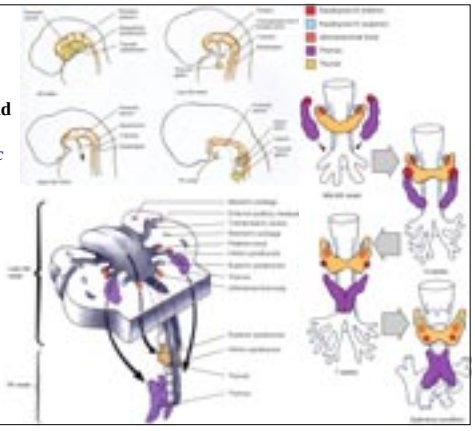
Endocrine glands

- Differentiate 2nd, 3rd mo
- Synthesize hormones
- Hypothalamic-pituitary vascular links 3rd mo
- Placental role in hormone production

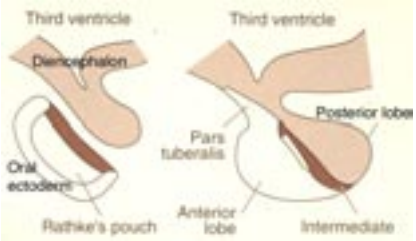


Thyroid and Parathyroid

Embryonic



Pituitary rudiments in embryo



Further development in fetus

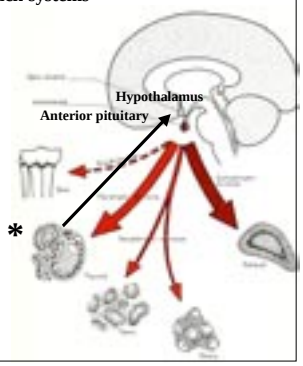
- **Neurovascular link hypothalamus and pituitary**
- **Coordination (feedback) endocrine systems**

Pituitary hormones

Hypothalamic-pituitary vascular connection
Feedback systems

Thyroid gland*

- **Histogenesis in embryo**
- **Colloid in follicles early fetus**
- **Thyroid hormone second trimester**
- **Pituitary TSH (Thyroid stimulating hormone)**
  Hypothalamus TRH (Thyrotropic releasing hormone)
  later second trimester



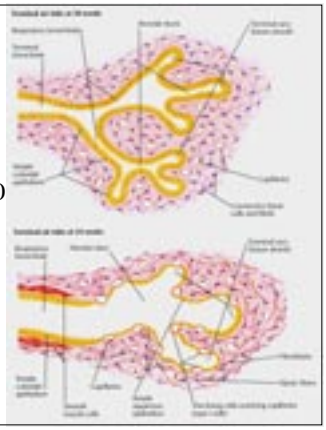
Respiratory System

Embryonic

- **8 wks**
  Diaphragm, lung anlagen

Fetal

- **12 wks**
  Gland like(pseudoglandular)
- **2nd trimester**
  Branching (canalicular, saccular) vasculature
- **26 wks**
  Surfactant
- **36 wks**
  Alveolar



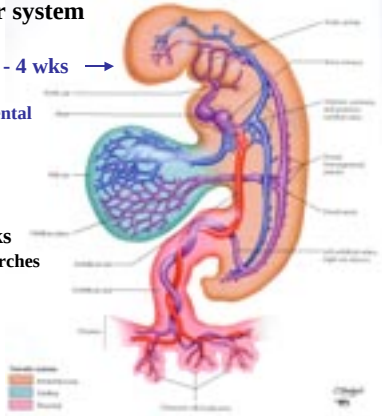
Cardiovascular system

Early embryonic - 4 wks →

- **heart constricted**
- **vitelline and placental circulation**

Early fetal - 9 wks

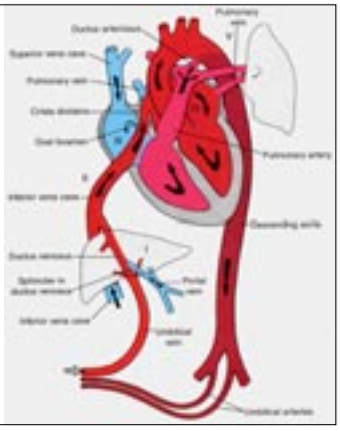
- **definitive aortic arches**
- **partitioned heart**



Fetal cardiovascular system

- **Enriched blood via umbilical vein, *ductus venosus*, IVC to RA, *foramen ovale* to LA to LV to aorta**

- **Depleted blood to RA, to RV to pulmonary artery, *ductus arteriosus*, aorta, umbilical arteries to placenta**



Early fetus 9wks

Second trimester 15 wks

Fetus early 2nd trimester

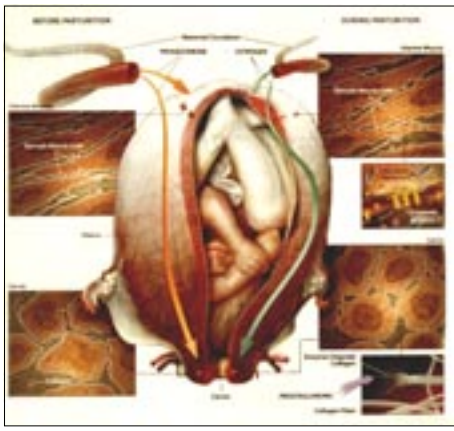
- Gut no longer herniated
- Dilute urine, metanephros
- Liver produces serum albumin, stores glycogen, secretes bile
- Lungs gland like
- Endocrine glands partially functional
- Myelination spinal roots and cord has begun
- Hiccup, swallow, gasp, yawn
- Gender differences recognizable

28 wks

- Gut, villi and crypts, peristalsis
- Surfactant in lungs Alveolar walls thinning
- Pituitary coordination of endocrine function
- Hematopoiesis liver, spleen, bone marrow
- Some myelination brain
- Response to sound
- Subcutaneous fat
- Skin keratinized, lanugo hair

End of fetal development - Term

- Stomach pH becomes acid, some digestive enzymes present
- Meconium in bowel (begins 4 mos)
- Testes descended
- Myelination of corticospinal tracts to level of medulla
- Lanugo hair replaced by adult hair
- Vernix caseosa covers the body (begins 18 wks)
- Fetus can suck
- Pupillary light reflex present



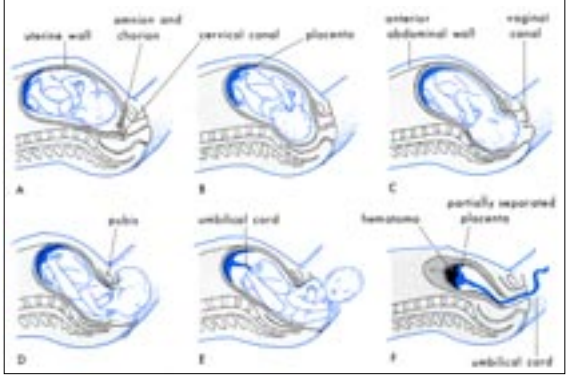
Parturition

Initiator of parturition in humans is unknown.

Uterine muscle becomes contractile. Gap junctions increase.

Collagenase softens cervix.

Stages of birth: 1. Dilation cervix (12 hrs); 2. Delivery fetus(1 hr); 3. Expulsion placenta (brief)

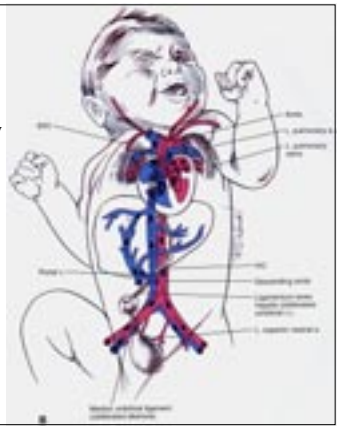


Birth- first breath, cry

- Inflation of lungs
- Pulmonary vasculature opens
- Increased oxygen saturation
- Grayish newborn turns healthy color

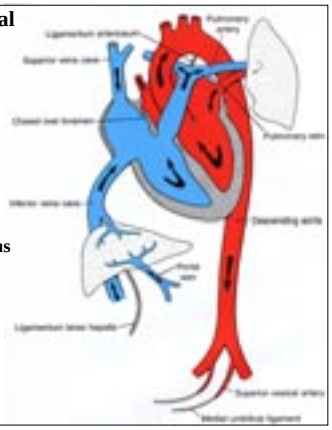
Apgar score

Activity (muscle tone, active movement)
Pulse (above 100 bmp)
Grimace (sneeze, cough, pulls away)
Appearance (entire body normal color)
Respiration (good, crying)



Cardiovascular- postnatal

- **Cutting umbilical cord - decreased blood to RA**
- **Closing of foramen ovale**
- **Expansion pulmonary circulation**
- **Closing of ductus arteriosus**
- **Separation of pulmonary and systemic circulations**
- **Ductus venosus closes**



The Miracle of Life

Lennart Nilsson

WGBH
NOVA

Some landmarks in fetal development

1. Beginning of fetal period – 9th week

The gut recanalizes, the midgut is herniated into umbilical cord, heart is partitioned, definitive aortic arches are formed, hematopoiesis ongoing in liver, diaphragm formed, ossification begun (clavicle), teeth are cap stage, tail has regressed, external genitalia indifferent, head is half crown rump length, there is a startle response

2. Beginning of the second trimester – 12 weeks

The midgut no longer herniated, dilute urine by metanephros, liver produces serum albumin, stores glycogen, secretes bile, endocrine glands formed but not fully functional, myelination spinal roots and spinal cord begun, lungs gland like, fetus can hiccup, swallow, gasp, yawn, gender differences visible

3. Earliest time of possible survival – 26-28 weeks

The gut has developed villi and crypts, peristalsis is present, surfactant secreted in lungs, alveolar walls thinning, hematopoiesis in liver, spleen and bone marrow, coordination of endocrines by pituitary, some myelination in brain, gyri, sulci are forming, fetus responds to sound, is covered by lanugo hair

4. End of fetal development - 38 weeks

The pH of stomach becomes acid, some digestive enzymes present (e.g., lactase), meconium in bowel, hematopoiesis only in bone marrow, testes descended, myelination of corticospinal tracts to level of medulla, lanugo hair replaced with adult hair, vernix caseosa covers the body, fetus can suck, pupillary light reflex present