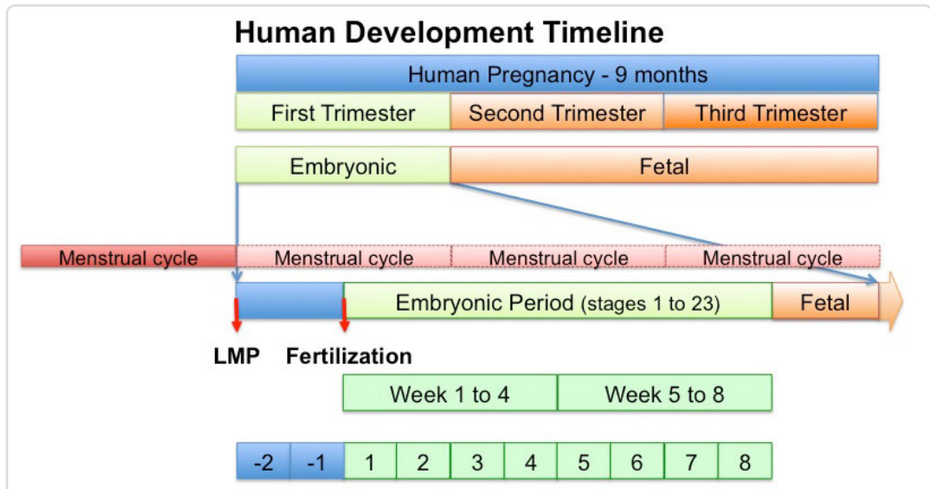
BGDA Lecture - Development of the Embryo/Fetus 2

Embryology (/embryology/index.php/Main_Page) - 14 May 2017 **(/embryology/index.php/File:Facebook_16x16.png)** **(/embryology/index.php/File:Pinterest_16x16.png)** **(/embryology/index.php/File:Twitter_16x16.png)** **[Expand] Expand to Translate**

Introduction

This lecture covers the period of Embryonic development, in Humans from week 3 to week 8 (**GA** (/embryology/index.php/Gestational_Age) week 5-10) and is divided into 23 Carnegie stages of embryonic development. There will also be a brief introduction to fetal development. Note, the period from week 9 to week 38 is considered Fetal development and will be covered in detail in the Laboratory 12 (/embryology/index.php/BGDA_Practical_-_Fetal_Development).



(/embryology/index.php/File:Human_development_timeline_gra

Lecture Objectives

- Understand key structures and events in embryonic development.
- Understanding of the dynamic changes internal and external structures.
- Brief understanding of organ and system formation (functional / not functional).
- Brief understanding of critical periods of development.

(/embryology/index.php/One_Minute_Embryology)

1 Minute Embryology (/embryology/index.php/One_Minute_Embryology#Human_Embryo) | UNSW theBox (https://thebox.unsw.edu.au/video/1-minute-embryology-human-embryo)

Lecture Archive [Expand]

Textbooks **[Collapse]**

UNSW Embryology

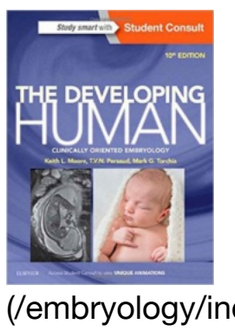
(/embryology/index.php/File:Logo.png)

Hill, M.A. (2017). *UNSW Embryology* (17th ed.) Retrieved May 14, 2017, from https://embryology.med.unsw.edu.au (https://embryology.med.unsw.edu.au)

- Week 3 (/embryology/index.php/Week_3) | Week 4 (/embryology/index.php/Week_4) | Week 5 (/embryology/index.php/Week_5) | Week 6 (/embryology/index.php/Week_6) | Week 7 (/embryology/index.php/Week_7) | Week 8 (/embryology/index.php/Week_8)
- Fetal Development (/embryology/index.php/Fetal_Development)
- Human Abnormal Development (/embryology/index.php/Human_Abnormal_Development) | Prenatal Diagnosis (/embryology/index.php/Prenatal_Diagnosis)
- Birth (/embryology/index.php/Birth) | Neonatal Development (/embryology/index.php/Neonatal_Development) | Neonatal Diagnosis (/embryology/index.php/Neonatal_Diagnosis)

The Developing Human: Clinically Oriented Embryology

Moore, K.L., Persaud, T.V.N. & Torchia, M.G. (2015). *The developing human: clinically oriented embryology* (10th ed.). Philadelphia: Saunders. (links only function with UNSW connection)



(/embryology/index.php/File:The_Developing_Human,_10th_edn.jpg)

Chapter 5 Fourth to Eighth Weeks of Human Development (http://ebookcentral.proquest.com.wwwproxy1.library.unsw.edu.au/lib/unsw/reader.action?docID=2074364&ppg=104)

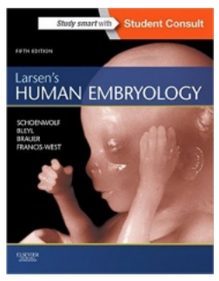
Chapter 6 Fetal Period (http://ebookcentral.proquest.com.wwwproxy1.library.unsw.edu.au/lib/unsw/reader.action?docID=2074364&ppg=132)

Chapter 20 Human Birth Defects (http://ebookcentral.proquest.com.wwwproxy1.library.unsw.edu.au/lib/unsw/reader.action?docID=2074364&ppg)

The Developing Human: Clinically Oriented Embryology (10th edn) [Expand]

Larsen's Human Embryology

Schoenwolf, G.C., Bleyl, S.B., Brauer, P.R., Francis-West, P.H. & Philippa H. (2015). *Larsen's human embryology* (5th ed.). New York; Edinburgh: Churchill Livingstone. (links only function with UNSW connection)



Chapter 4 Fourth Week: Forming the Embryo (http://ebookcentral.proquest.com.wwwproxy1.library.unsw.edu.au/lib/unsw/reader.action?docID=2074524&ppg=100)

Chapter 6 Fetal Development and the Fetus as Patient (http://ebookcentral.proquest.com.wwwproxy1.library.unsw.edu.au/lib/unsw/reader.action?docID=2074524&ppg=151)

Larsen's Human Embryology (5th edn) [Expand]

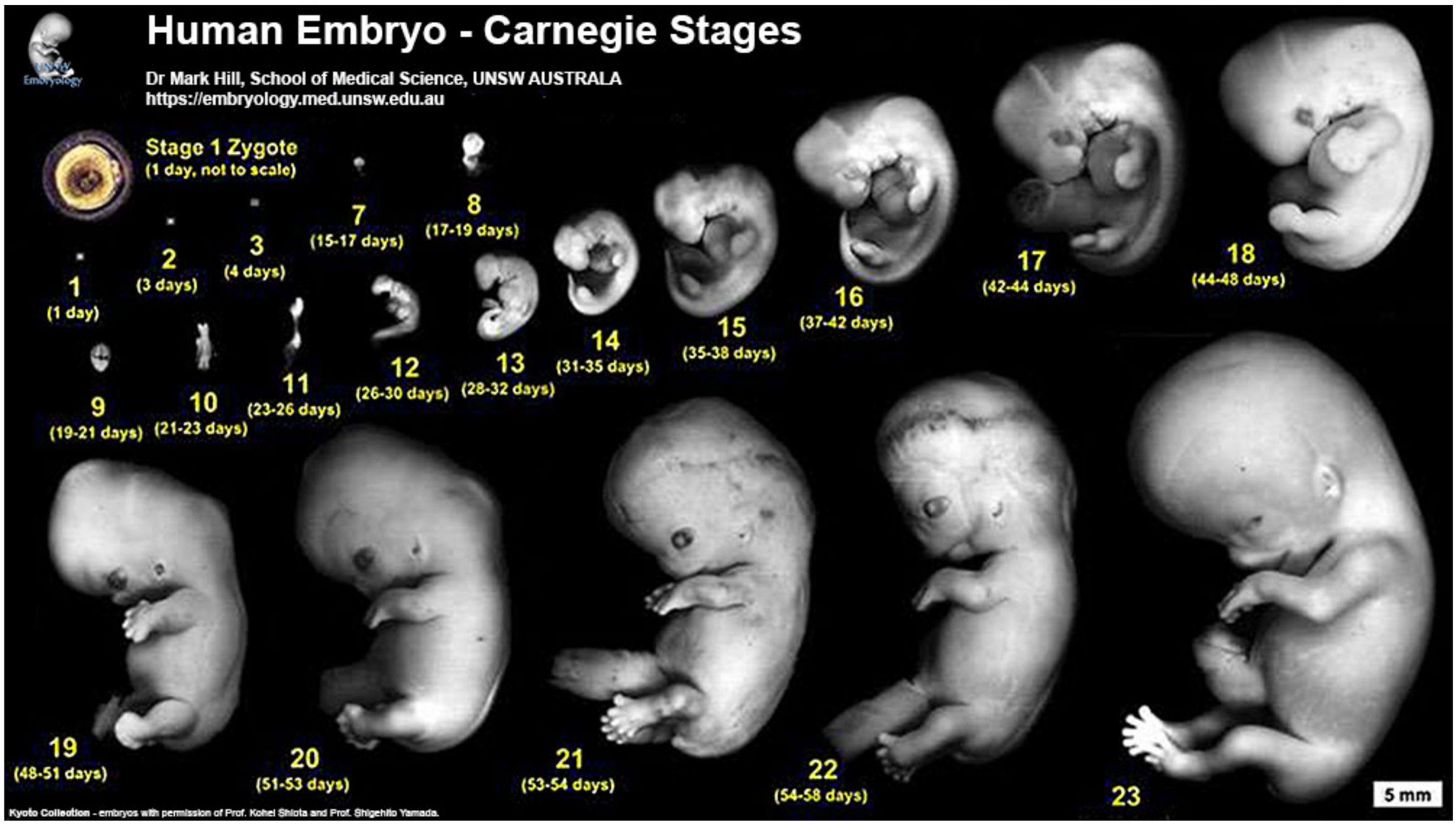
(/embryology/index.php/File:Larsen%27s_human_embryology_5th_ed.jpg) **Larsen's Human Embryology (5th edn) [Expand]**

More Textbooks? (/embryology/index.php/Embryology_Textbooks)

BGDA Practical Classes

Practical 3 - Fertilization to Implantation (/embryology/index.php/BGDA_Practical_-_Fertilization_to_Implantation)	**Practical 6 - Implantation to 8 Weeks** (/embryology/index.php/BGDA_Practical_-_Implantation_to_8_Weeks)	**Practical 12 - Fetal Period** (/embryology/index.php/BGDA_Practical_-_Fetal_Development)
	Practical 14 - Placenta and Fetal Membranes (/embryology/index.php/BGDA_Practical_-_Placenta_and_Fetal_Membranes)	

First 8 Weeks



(/embryology/index.php/File:Human_Carnegie_stage_1-23.jpg)

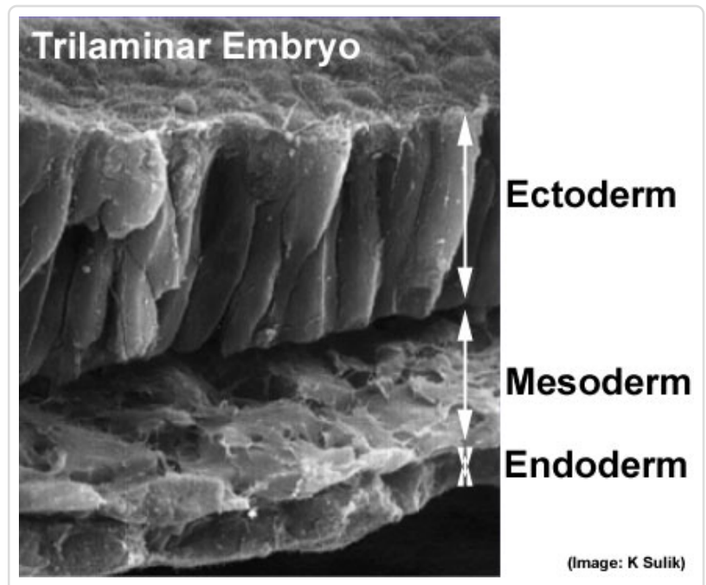
The Carnegie stages of the first 8 week of human development.

Week 3

Mesoderm means the "middle layer" and it is from this layer that the body's connective tissues are derived (note that the head neural crest ectoderm also forms connective tissues)

In early mesoderm development a number of transient structures will form and then be lost as tissue structure is patterned and organised.

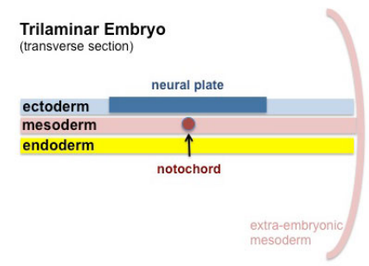
Humans as vertebrates have a "backbone" and the first mesoderm structure we will see form after the notochord will be somites.



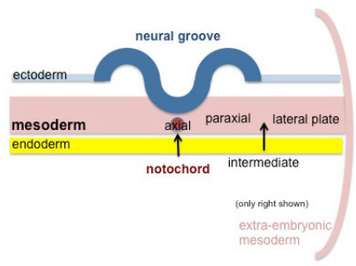
(/embryology/index.php/File:Trilaminar_embryo.

Week 3 - Gastrulation

Mesoderm and Ectoderm Cartoons



(/embryology/index.php/File:Mesoderm-cartoon1.jpg)



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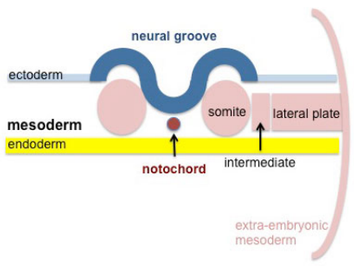

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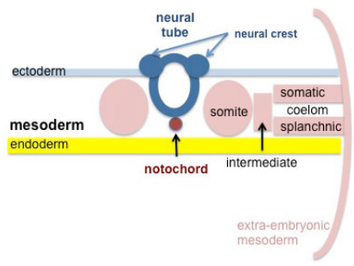
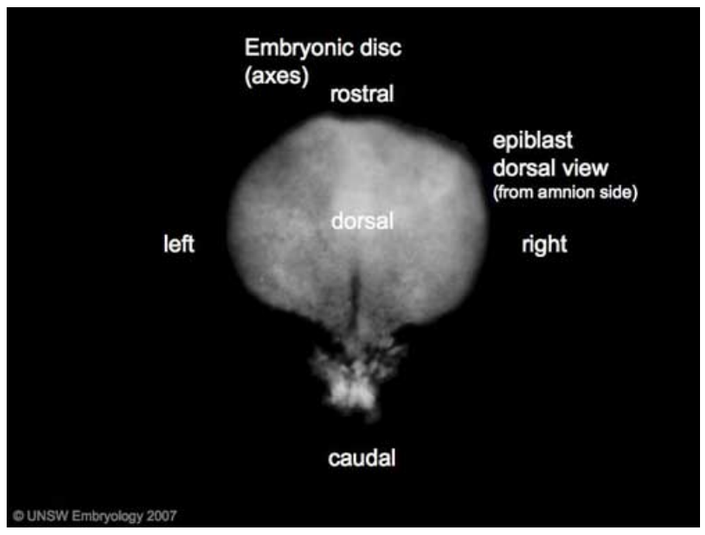


(/embryology/index.php/File:Mesoderm-cartoon4.jpg)

Mesoderm organization: (left to right)

lateral plate - intermediate mesoderm - paraxial mesoderm - axial mesoderm - paraxial mesoderm - intermediate mesoderm - lateral plate



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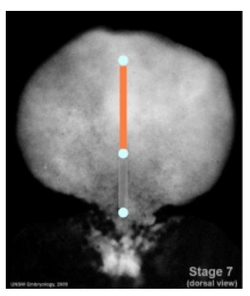
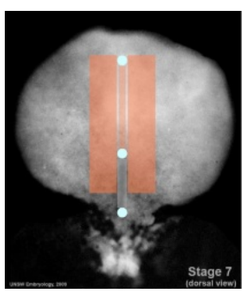


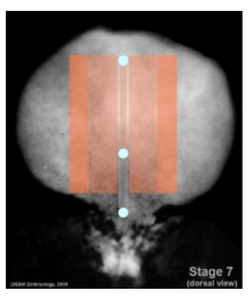
(/embryology/index.php/File:Stage7_axial-mesoderm.jpg)

axial mesoderm



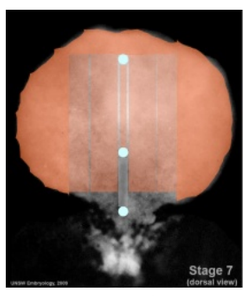
(/embryology/index.php/File:Stage7_paraxial-mesoderm.jpg)

Stage 7 paraxial mesoderm



(/embryology/index.php/File:Stage7_intermediate-mesoderm.jpg)

Stage 7 intermediate mesoderm



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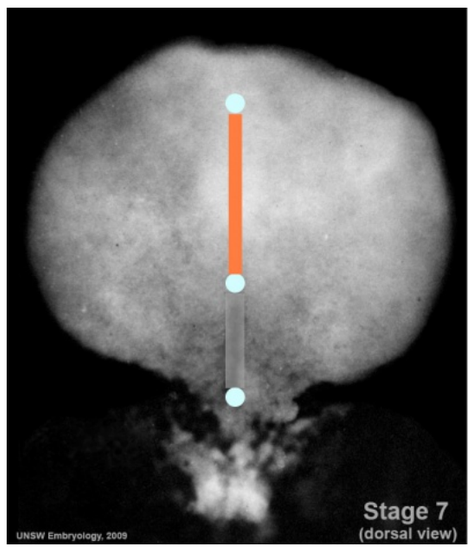
Stage 7 lateral plate

Axial Mesoderm

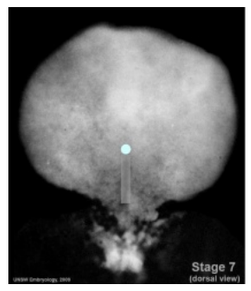


(/embryology/index.php/File:Stage7_notochord.jpg)

- Axial Mesoderm = notochord

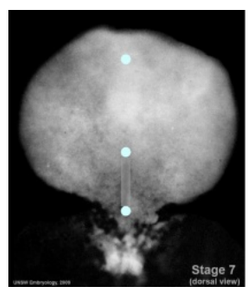
1. mechanical role in embryonic disc folding
2. molecular role in patterning surrounding tissues

Adult - contributes to the nucleus pulposis of the intervertebral disc



(/embryology/index.php/File:Stage7_primitive-streak-node.jpg)

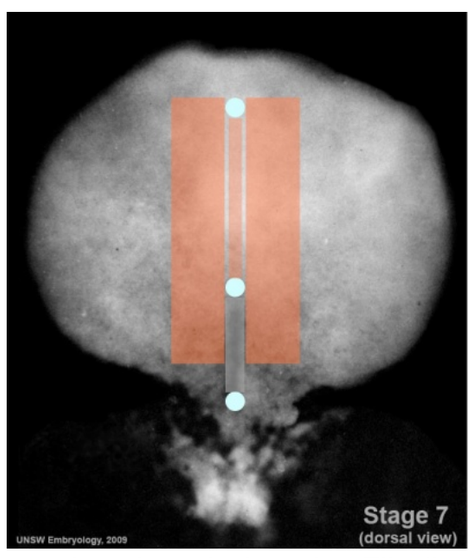
Stage 7 primitive-streak-node



(/embryology/index.php/File:Stage7_cloacal-oral-membranes.jpg)

Stage 7 cloacal-oral-membranes

Paraxial Mesoderm



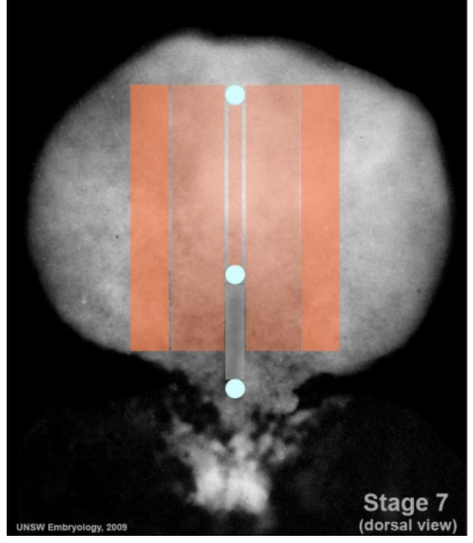
(/embryology/index.php/File:Stage7_paraxial-mesoderm.jpg)

- differentiates rostro-caudally (head to tail)
- head region - remains unsegmented
- body region - segments to form pairs of **somites** along the length of the embryo.

Adult - contributes vertebral column (vertebra and IVD), dermis of the skin, skeletal muscle of body and limbs

Intermediate Mesoderm

- named by position (between paraxial and lateral plate)
- differentiates rostro-caudally (head to tail)

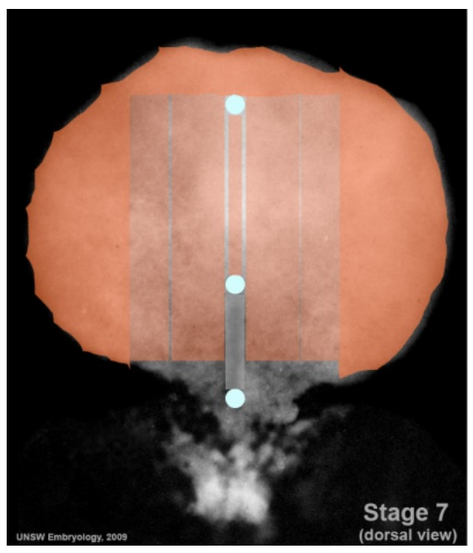


- forms 3 sets of "kidneys" in sequence
1. pronephros
2. mesonephros
3. metanephros

Adult - metanephros forms the kidney

(/embryology/index.php/File:Stage7_intermediate-mesoderm.jpg)

Lateral Plate Mesoderm



(/embryology/index.php/File:Stage7_lateral-plate.jpg)

- at edge of embryonic disc
- "horseshoe shaped" space forms in the middle, dividing this region
  - somatic mesoderm - closest to ectoderm
  - intra-embryonic coelom - single space forms the 3 major body cavities (pericardial, pleural, peritoneal)
  - splanchnic mesoderm - closest to endoderm

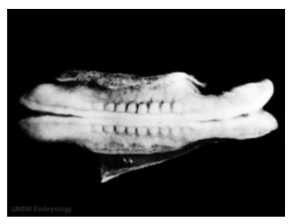
Adult - body connective tissues, gastrointestinal tract (connective tissues, muscle, organs), heart

Week 4

Somite Development

(/embryology/index.php/File:Stage10_if4b.jpg)

Stage 10 (early)



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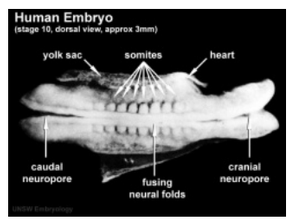
Stage 10 (late)

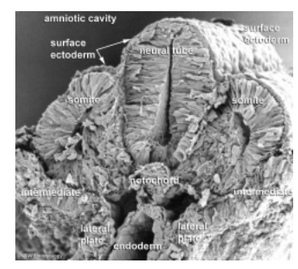


(/embryology/index.php/File:Stage10_if5b.jpg)

Stage 10 (labeled)

(/embryology/index.php/File:Stage11_sem13.jpg)

Stage 11



(/embryology/index.php/File:Stage11_sem100.jpg)

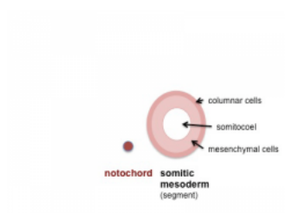
Stage 11

Somite initially forms 2 main components

- ventromedial- sclerotome forms vertebral body and intervertebral disc
- dorsolateral - dermomyotome forms dermis and skeletal muscle

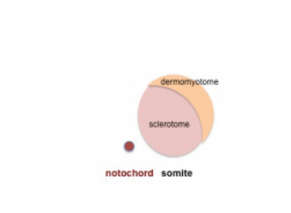
(/embryology/index.php/File:Somite_cartoon1.png)

paraxial mesoderm



(/embryology/index.php/File:Somite_cartoon2.png)

early somite

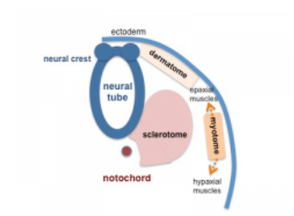


(/embryology/index.php/File:Somite_cartoon3.png)

sclerotome and dermomyotome

(/embryology/index.php/File:Somite_cartoon4.png)

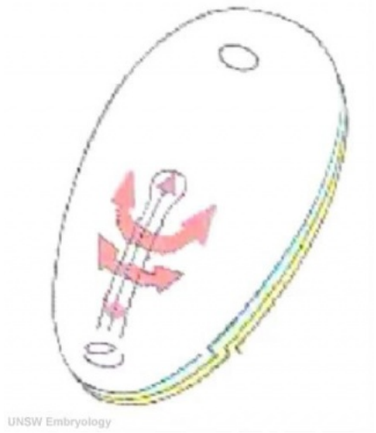
dermatome and myotome



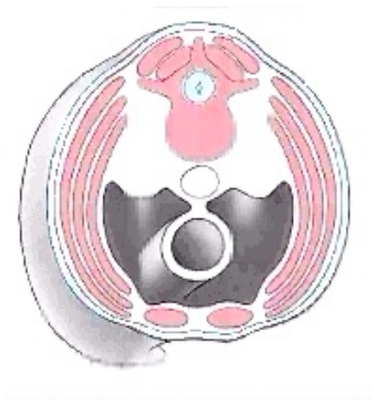
(/embryology/index.php/File:Somite_cartoon5.png)

epaxial and hypaxial muscles

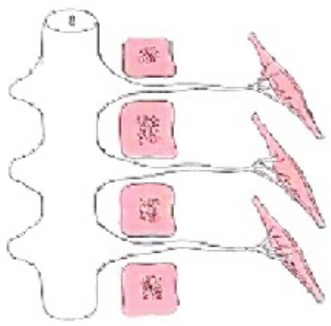
Template:Somite parts table (/embryology/index.php?title=Template:Somite_parts_table&action=edit&redlink=1)



(/embryology/index.php/Mesoderm_Movie)



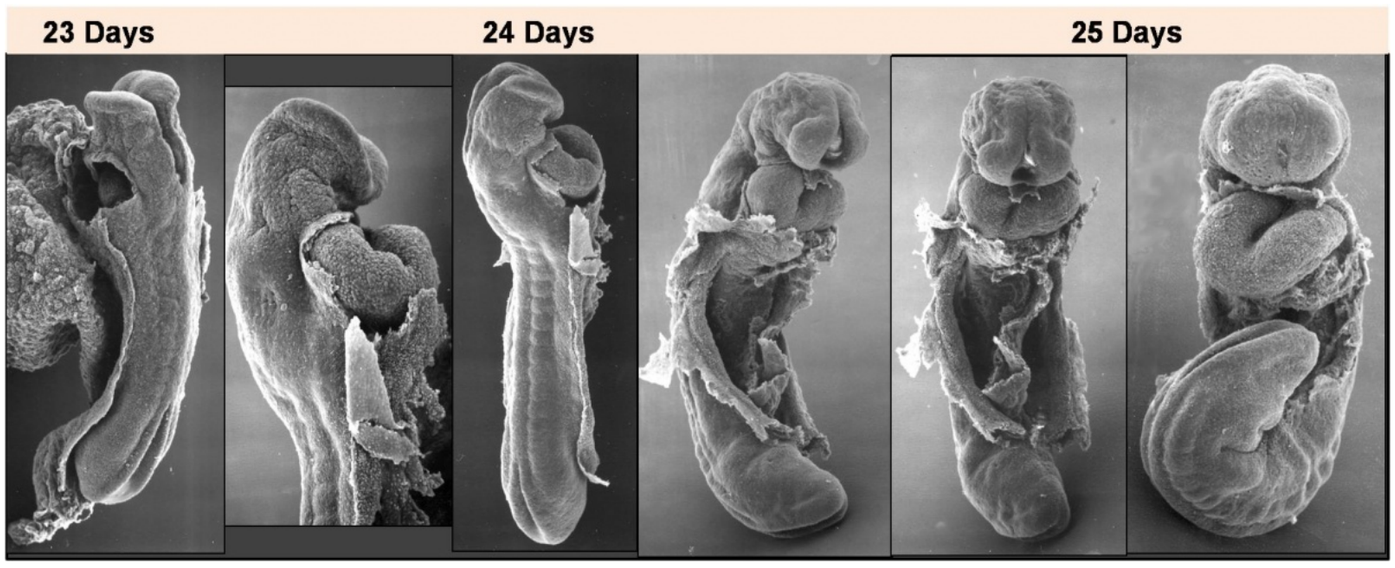
(/embryology/index.php/Somite_Musculoskeletal_Movie)



(/embryology/index.php/Vertebra_Development_Movie)

Heart

Heart Development Movies [Expand]



(/embryology/index.php/File:Heart_Looping_Sequence_(SEMs).jpg)

- forms initially in splanchnic mesoderm of prechordal plate region - **cardiogenic region**
  - growth and folding of the embryo moves heart ventrallly and downward into anatomical position
- week 3 begins as paired heart tubes that fuse to form single heart tube
- begins to beat in Humans- day 22-23
- heart tube connects to blood vessels forming in splanchnic and extraembryonic mesoderm

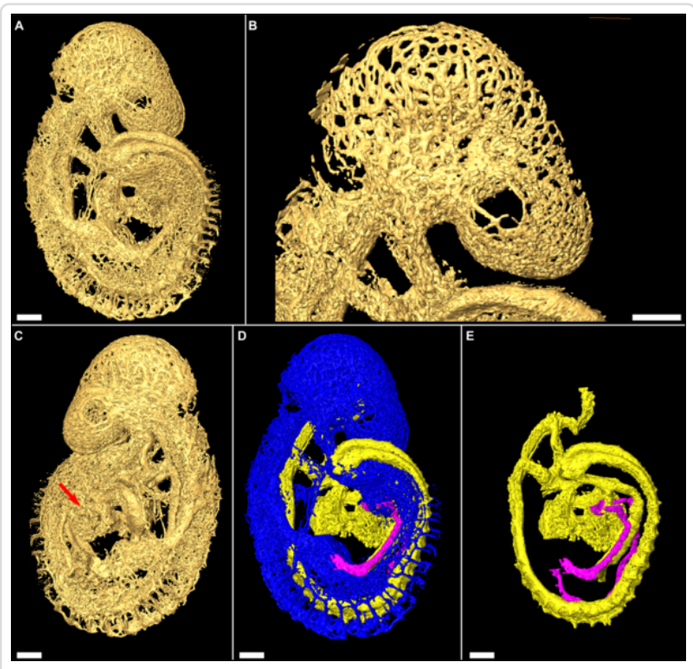
Week 2-3 pair of thin -walled tubes

Week 3 tubes fused, truncus arteriosus outflow, heart contracting

Week 4 heart tube continues to elongate, curving to form S shape

Week 5 Septation starts, atrial and ventricular

Links: Cardiac Embryology (/embryology/index.php/Cardiac_Embryology)

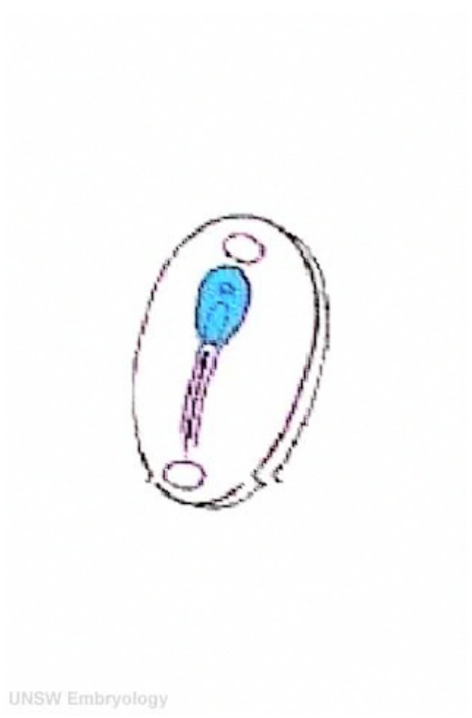


(/embryology/index.php/File:Mouse_embryo_va

Mesoderm vascular development

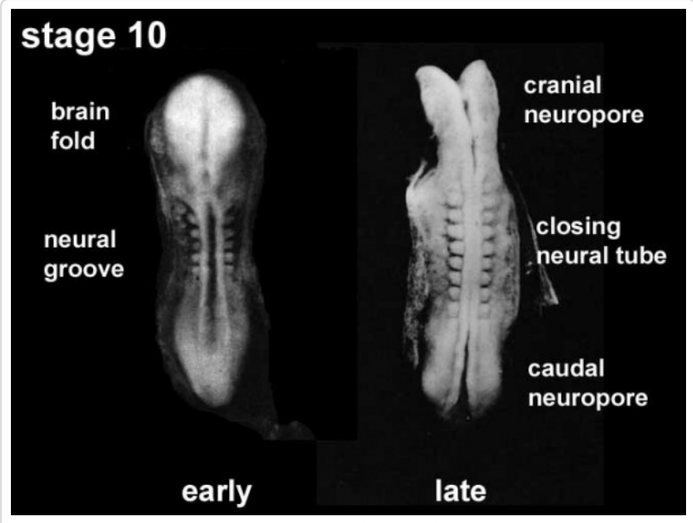
Neural

Neural Plate



(/embryology/index.php/Neural_Plate_Movie)

- extends from buccopharyngeal membrane to primitive node
- forms above notochord and paraxial mesoderm
- neuroectodermal cells
  - broad brain plate
  - narrower spinal cord
- 3 components form: floor plate, neural plate, neural crest



(/embryology/index.php/File:Stage10_neural_sr

Stage 10 Week 4, 22 - 23 days

Neural Groove

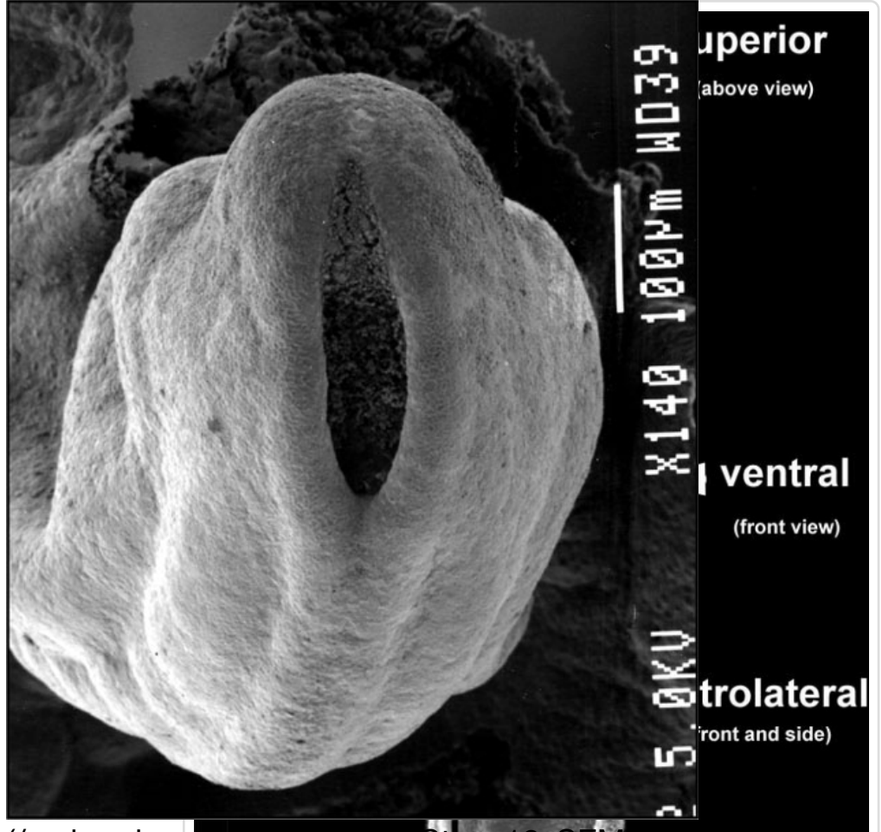
- forms in the midline of the neural plate (day 18-19)
- either side of which are the neural folds which continues to deepen until about week 4
- neural folds begins to fuse, beginning at 4th somite level

Neural Tube

(/embryology/index.php/Neural_Tube_Movie)

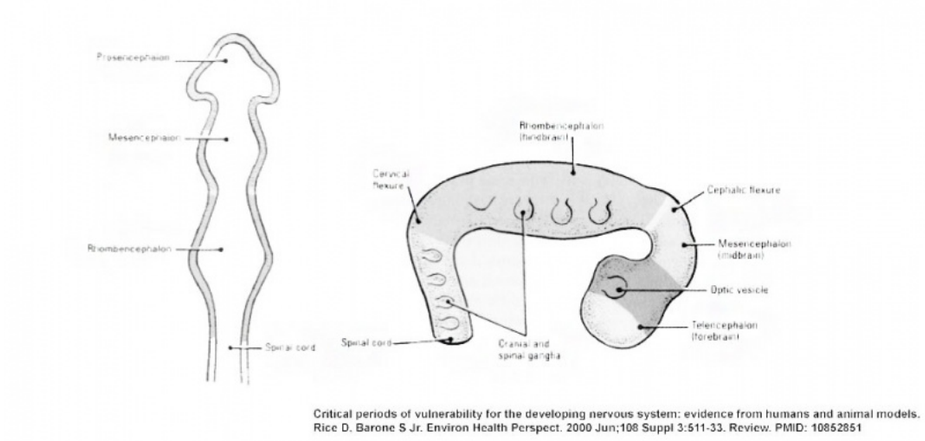
- the neural tube forms the brain and spinal cord
- fusion of neural groove extends rostrally and caudally
- begins at the level of 4th somite
- closes neural groove "zips up" in some species.
  - humans appear to close at multiple points along the tube.
- leaves 2 openings at either end - **Neuropores**
  - cranial neuropore closes before caudal

Failure for the neural tube to close correctly or completely results in a **neural tube defect**.



(/embryology/index.php/File:Stage11_sem6.jpg

Stage 11 neural groove to tube



(/embryology/index.php/File:CNS_primary_vesicles.jpg)

Neural - 3 primary vesicles

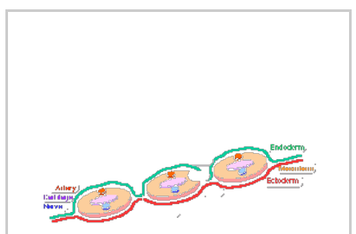
Neural Crest

- population of cells at the edge of the neural plate that lie dorsally when the neural tube fuses
- dorsal to the neural tube, as a pair of streaks
- pluripotential, forms many different types of cells
- cells migrate throughout the embryo

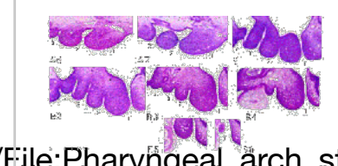
Neural Crest Derivatives: dorsal root ganglia, autonomic ganglia, adrenal medulla, drg sheath cells, glia, pia-arachnoid sheath, skin melanocytes, connective tissue of cardiac outflow, thyroid parafollicular cells, craniofacial skeleton, teeth odontoblasts

Head

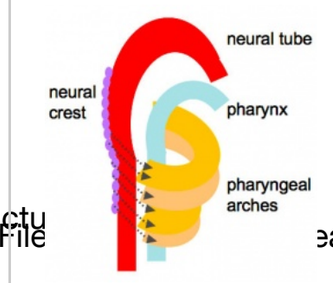
- branchial arch (Gk. *branchia*= gill)
- arch consists of all 3 trilaminar embryo layers (ectoderm- outside, mesoderm - core of mesenchyme, endoderm - inside)



(/embryology/index.php/File:Pharyngeal_arch_structu

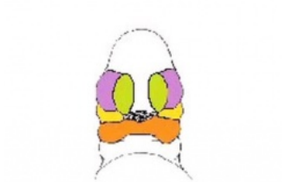


(/embryology/index.php/File eal_arch_excerpts.gif)

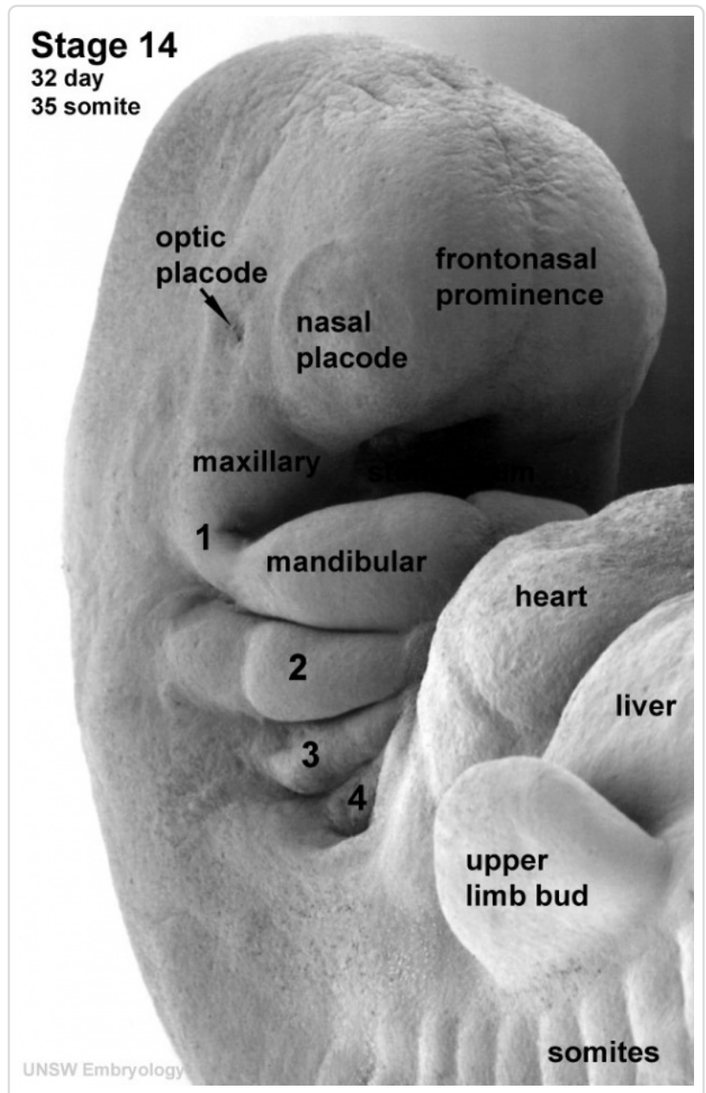


(/embryology/index.php/File:Head_arches_cartoon.jpg)

- Humans have 5 arches - 1, 2, 3, 4, 6 (Arch 5 does not form or regresses rapidly)
- from in rostro-caudal sequence, Arch 1 to 6 from week 4 onwards
- arch 1 and 2 appear at time of closure of cranial neuropore
- Face - mainly arch 1 and 2
- Neck components - arch 3 and 4 (arch 4 and 6 fuse)



(/embryology/index.php/Face_Development_Movie)



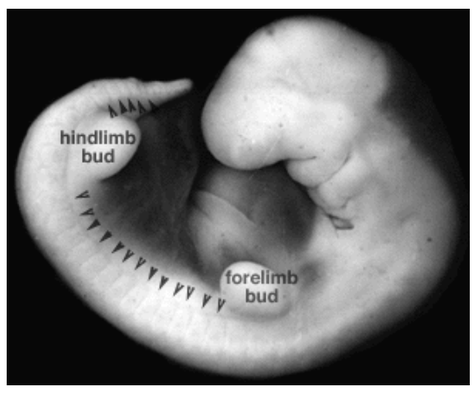
(/embryology/index.php/File:Stage14_sem2l.jpg

Stage 14 pharyngeal arches

Sensory Placodes

- During week 4 a series of thickened surface ectodermal patches form in pairs rostro-caudally in the head region.
- These sensory placodes will later contribute key components of each of our special senses (vision, hearing and smell).
- Note that their initial postion on the developing head is significantly different to their final position in the future sensory system
- **Otic placode** - istage 13/14 embryo the otic placode sunk from the surface ectoderm to form a hollow epithelial ball, the **otocyst**, which now lies beneath the surface surrounded by mesenchyme (mesoderm). The epithelia of this ball varies in thickness and has begun to distort, it will eventually form the inner ear membranous labyrinth.
- **Lens placode** - lies on the surface, adjacent to the outpocketing of the nervous system (which will for the retina) and will form the lens.
- **Nasal placode** - has 2 components (medial and lateral) and will form the nose olefactory epithelium.

Upper and Lower Limb



(/embryology/index.php/File:Stage14_somites_limbbuds.png)

- Limb development occurs at different times for forelimbs and hindlimbs.
- mid-4th week human upper limb buds first
- lower limbs about 2 days later
- The limbs form at vertebra segmental levels C5-C8 (upper limbs) L3-L5 (lower limbs).
- Limbs are initially undifferentiated mesenchyme (mesoderm) with an epithelial (ectoderm) covering.
- Blood vessels then begin forming, the largest (marginal vein) is adjacent to tip of the bud.
- Myotome invade the bud.

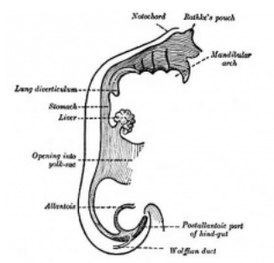
Gastrointestinal Tract

- Begins at buccopharyngeal membrane
- Ends at cloacal membrane
- 3 distinct portions (fore-, mid- and hind-gut)
- liver earliest forming organ

Germ layer contributions

- **Endoderm** - epithelium and associated glands
- **Mesoderm** (splanchnic) - mesentry, connective tissues, smooth muscle, blood vessels
- **Ectoderm** (neural crest) - enteric nervous system

Both endoderm and mesoderm will contribute to associated organs.



(/embryology/index.php/File:Gray0982a.jpg)

Gastrointestinal Tract

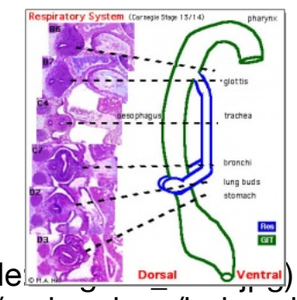
Week 5

(/embryology/index.php/File:Stage14_sem1c.jpg)

Stage 14

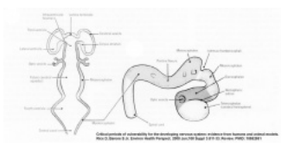

(/embryology/index.php/File:Stage14_sem1c.jpg)

Stage 15



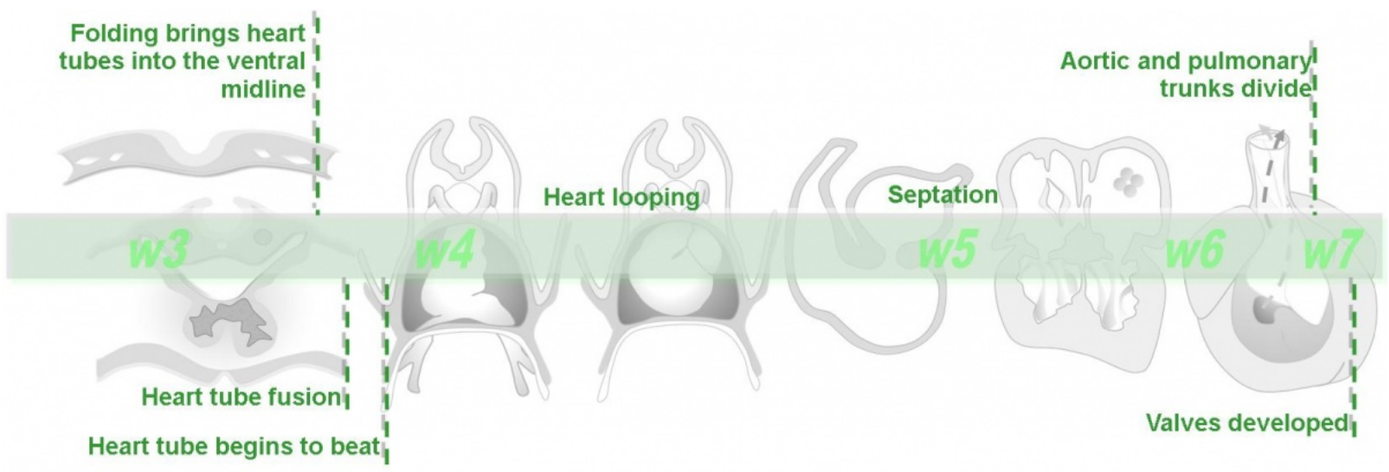
(/embryology/index.php/File:Stage14_respiratory_tract.jpg)

Respiratory Tract


(/embryology/index.php/File:CNS_secondary_vesicles.jpg)

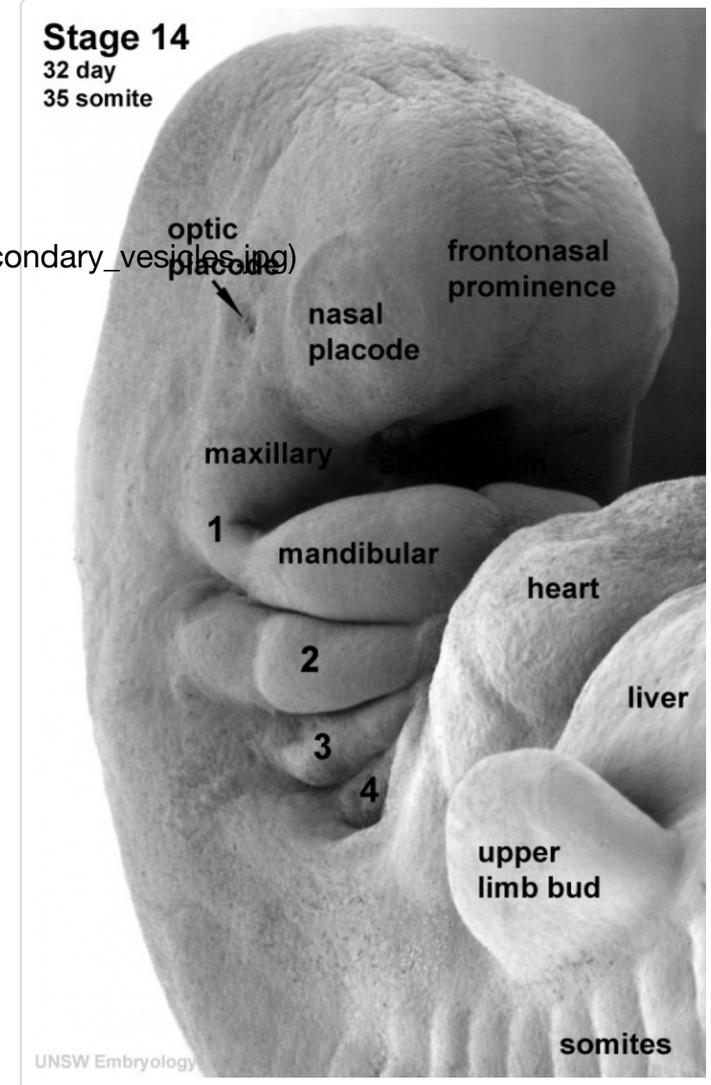
Neural - 5 secondary vesicles

- Heart - septation starts, atrial and ventricular
- Vascular - 3 vascular systems (systemic, placental, vitelline) extensively remodelled
- Respiratory - left and right lung buds push into the pericardioperitoneal canals (primordia of pleural cavity)
- Sense - Hearing cochlear part of otic vesicle elongates (humans 2.5 turns)



(/embryology/index.php/Cardiac_Embryology)

Septation continues, atrial septa remains open, foramen ovale



(/embryology/index.php/File:Stage14_sem2l.jpg

Stage 14 pharyngeal arches

Week 6

(/embryology/index.php/File:Stage16_bf1c.jpg)

Stage 16

(/embryology/index.php/File:Stage17_bf1c.jpg)

Stage 17

(/embryology/index.php/File:Stage16-18_face.jpg)

Week 6 Face Development

- Endocrine development
  - Pituitary - connecting stalk between pouch and oral cavity degenerates
  - Parathyroid - diverticulum elongate, hollow then solid, dorsal cell proliferation
  - Thymus - diverticulum elongate, hollow then solid, ventral cell proliferation
  - Adrenal - fetal cortex forms from mesothelium adjacent to dorsal mesentery, medulla neural crest cells from adjacent sympathetic ganglia

Week 7


(/embryology/index.php/File:Stage18_bf1c.jpg)

Stage 18

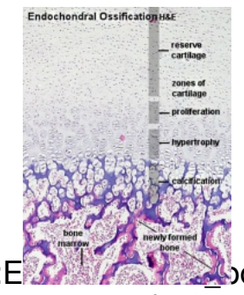

(/embryology/index.php/File:Stage19_bf1c.jpg)

Stage 19

- Pancreas - Week 7 to 20 pancreatic hormones secretion increases, small amount maternal insulin
- Limb bones form by endochondrial ossification and throughout embryo replacement of cartilage with bone (week 5 onward).

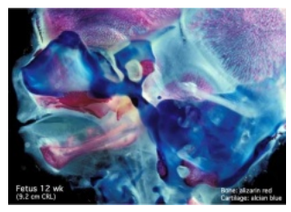
(/embryology/index.php/File:E_bone.jpg)

Endochondral ossification in limb



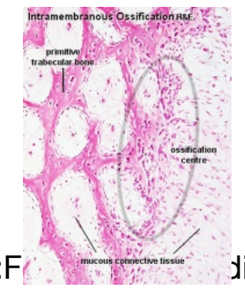
(/embryology/index.php/File:Endochondral_ossification.jpg)

Endochondral ossification



(/embryology/index.php/File:F dial.jpg)

Head Intramembranous ossification



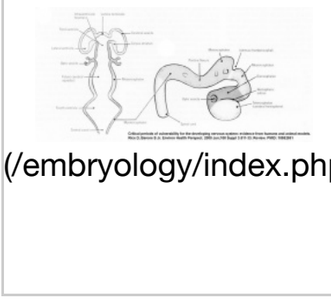
(/embryology/index.php/File:Ossification_centre.jpg)

Intramembranous ossification

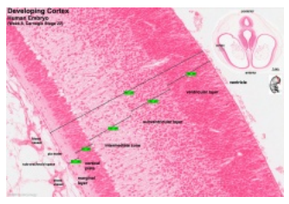

(/embryology/index.php/File:Stage19_bf2b.jpg)

Human week 7

Week 8

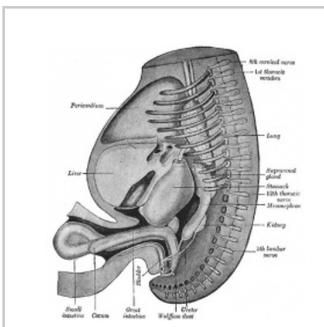

(/embryology/index.php/File:CNS_secondary_vesicles.jpg)

Neural - secondary vesicles

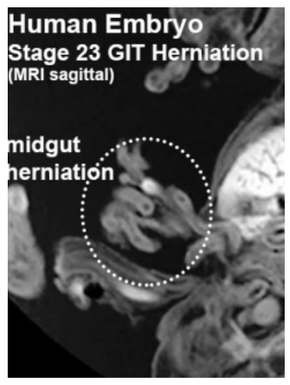


(/embryology/index.php/File:Stage_22_image_217.jpg)

Neural - early developing cortex


(/embryology/index.php/File:Gray0986.jpg)

Gastrointestinal tract herniation

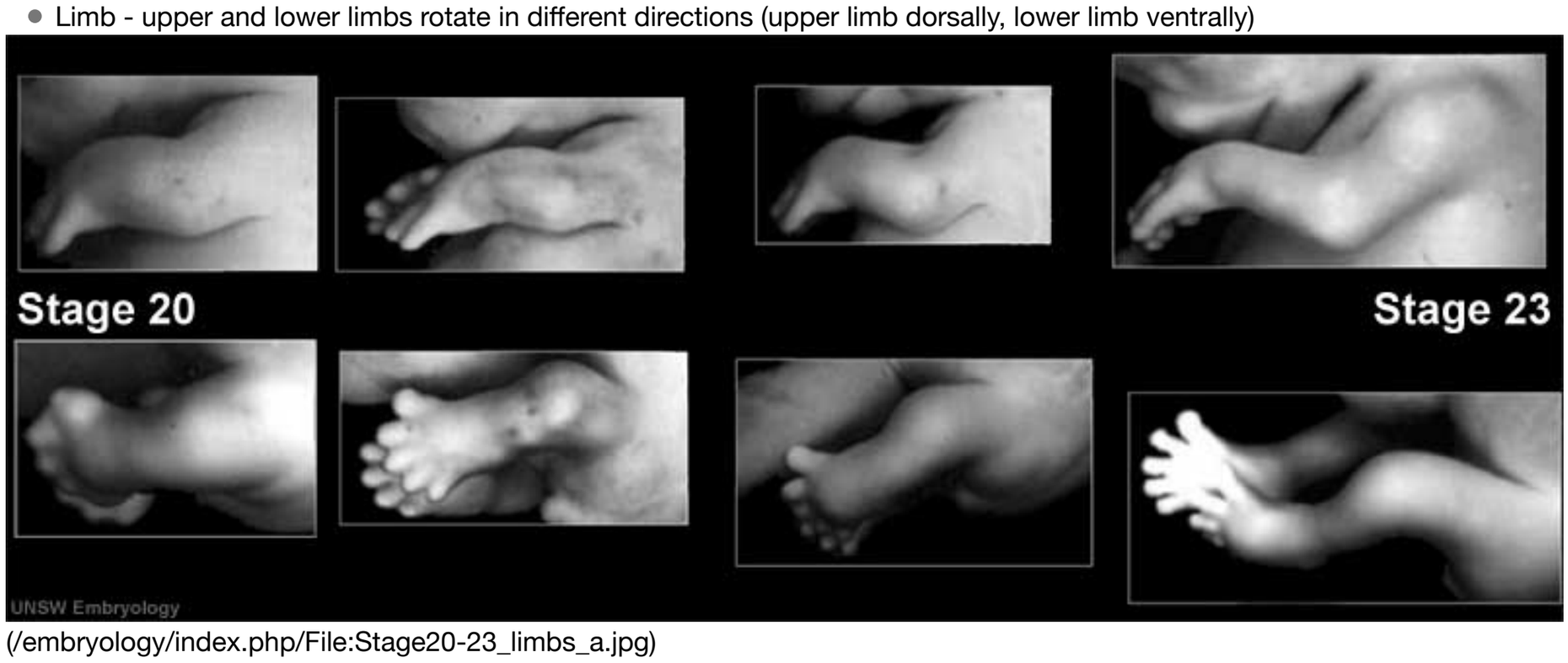


(/embryology/index.php/Stage_23_MRI_Movie_7)

Sagittal GIT

Page (/embryology/index.php/Stage_23_MRI_Movie_7) | Play (/embryology/images/8/83/Stage23_MRI_S04.mp4)

- Limb - upper and lower limbs rotate in different directions (upper limb dorsally, lower limb ventrally)



(/embryology/index.php/File:Stage20-23_limbs_a.jpg)

Links: Embryonic Development (/embryology/index.php/Embryonic_Development) | Timeline human development (/embryology/index.php/Timeline_human_development)

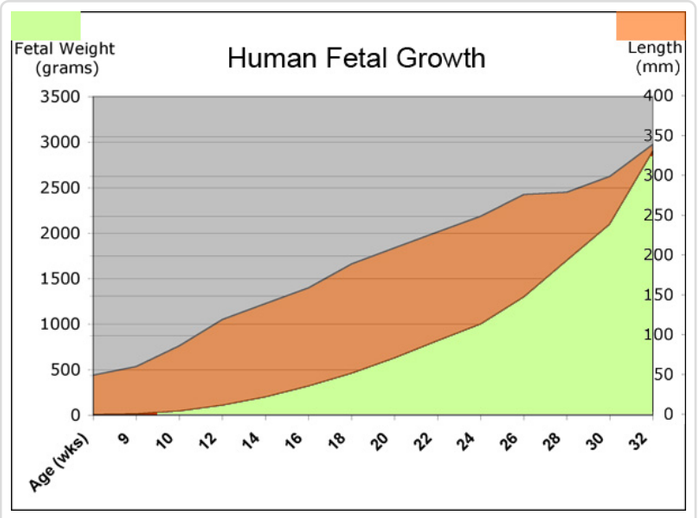
Fetal

- First Trimester (1 - 12 weeks) - embryonic and early fetal
- Second Trimester (13 - 24 weeks) - organ development and function, growth (length)
- Third Trimester (25 - 40 weeks) - organ function and rapid growth (weight)

Fetal Neural

- During the fetal period there is ongoing growth in size, weight and surface area of the brain and spinal cord. Microscopically there is ongoing: cell migration, extension of processes, cell death and glial cell development.
- Brain - folding of the initially smooth surface (insular cortex, gyral and culcal development)
- Neural development will continue after birth with substantial growth, death and reorganization occuring during the postnatal period

Links: BGDA Lecture - Nervous System (/embryology/index.php/BGDA_Lecture_-_Development_of_the_Nervous_System) | Neural System Development (/embryology/index.php/Neural_System_Development)



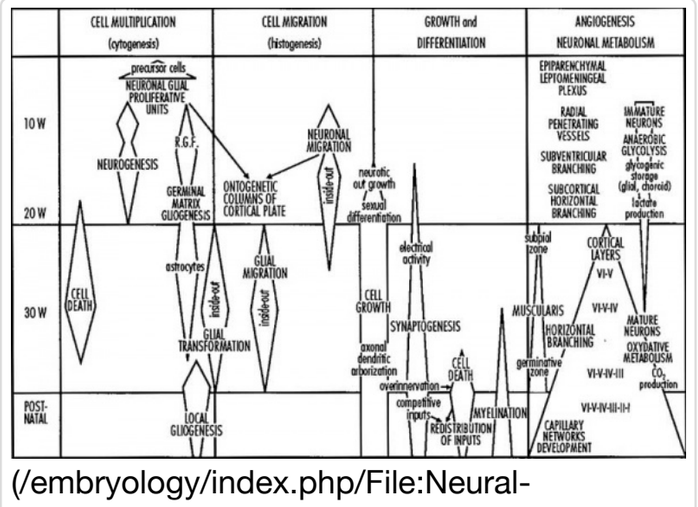
(/embryology/index.php/File:Fetal_length_and_v

Fetal length and weight changes

Lung Stages

- week 4 - 5 embryonic
- week 5 - 17 pseudoglandular
- week 16 - 25 canalicular
- week 24 - 40 terminal sac
- late fetal - 8 years alveolar

Links: SH Lecture - Respiratory (/embryology/index.php/SH_Lecture_-_Respiratory_System_Development) | Respiratory System Development (/embryology/index.php/Respiratory_System_Development)



(/embryology/index.php/File:Neural-development.jpg)

Timeline of events in Human Neural Development

Fetal Genital

- Gonad - ovary and testis development
- Internal genital tract - uterus and ductus deferens
- External genital tract - genital folds development
- Testis descent

Links: BGDB Lecture - Genital (/embryology/index.php/BGD_Lecture_-_Sexual_Differentiation) | Genital System Development (/embryology/index.php/Genital_System_Development)

Fetal Renal

- week 32-34 nephron development completed
- term birth nephron number per kidney about 1 million (300,000 to 2 million)

Links: Renal System Development (/embryology/index.php/Renal_System_Development)

Fetal Endocrine

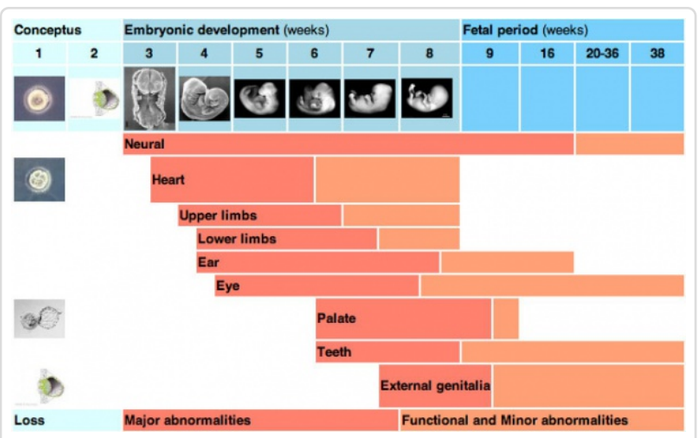
- Many endocrine organs begin to function in the early fetal period.
- Pituitary hormones - HPA axis established by week 20, pituitary functional throughout fetal development
- Thyroid hormone - important for neural development, required for metabolic activity, also in the newborn

Remember that the Placenta also has important endocrine functions during development.

Links: Endocrine System Development (/embryology/index.php/Endocrine_System_Development) | Placenta Development (/embryology/index.php/Placenta_Development)

Critical Periods

The term "Critical Periods" refers to periods of development when specific systems are more sensitive to teratogen (/embryology/index.php/T#teratogen) exposure or developmental insults.

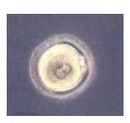


(/embryology/index.php/File:Human-critical_periods_of_development.jpg)

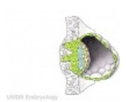
Critical Periods of Human Development (/embryology/index.php/Human_Abnormal_Development)

Conceptus **Embryonic development** (weeks)

1 **2** **3**



(/embryology/index.php/File:Early_zygote.jpg)



(/embryology/index.php/File:Week2_001_icon.jpg)

(/embryology/index.php/File:Stage9_sem4c.jpg)

(/embryology/index.php

Neural

(/embryology/index.php/File:Stage2.jpg)

Heart

Upper limbs

Lower

Ear

(/embryology/index.php/File:CSt3.jpg)

(/embryology/index.php/File:Week2_001_icon.jpg)

Loss **Major abnormalities**

Abnormality Links (/embryology/index.php/Human_Abnormal_Development): Introduction (/embryology/index.php/Human_Abnormal_Development) | Genetic (/embryology/index.php/Abnormal_Development_-_Genetic) | Environmental (/embryology/index.php/Abnormal_Development_-_Environmental) | Unknown (/embryology/index.php/Abnormal_Development_-_Unknown) | Teratogens (/embryology/index.php/Abnormal_Development_-_Teratogens) | Cardiovascular (/embryology/index.php/Cardiovascular_System_-_Abnormalities) | Coelomic Cavity (/embryology/index.php/Coelomic_Cavity_-_Abnormalities) | Endocrine (/embryology/index.php/Endocrine_System_-_Abnormalities) | Gastrointestinal Tract (/embryology/index.php/Gastrointestinal_Tract_-_Abnormalities) | Genital (/embryology/index.php/Genital_System_-_Abnormalities) | Head (/embryology/index.php/Head_Development_-_Abnormalities) | Integumentary (/embryology/index.php/Integumentary_System_-_Abnormalities) | Musculoskeletal (/embryology/index.php/Musculoskeletal_System_-_Abnormalities) | Limb (/embryology/index.php/Musculoskeletal_System_-_Limb_Abnormalities) | Neural (/embryology/index.php/Neural_System_-_Abnormalities) | Neural Crest (/embryology/index.php/Neural_Crest_System_-_Abnormalities) | Renal (/embryology/index.php/Renal_System_-_Abnormalities) | Respiratory (/embryology/index.php/Respiratory_System_-_Abnormalities) | Placenta (/embryology/index.php/Placenta_-_Abnormalities) | Sensory (/embryology/index.php/Sensory_System_-_Abnormalities) | Hearing (/embryology/index.php/Sensory_-_Hearing_Abnormalities) | Vision (/embryology/index.php/Sensory_-_Vision_Abnormalities) | Twinning (/embryology/index.php/Abnormal_Development_-_Twinning) | Developmental Origins of Health and Disease (/embryology/index.php/Abnormal_Development_-_Developmental_Origins_of_Health_and_Disease) | ICD-10 (/embryology/index.php/International_Classification_of_Diseases)

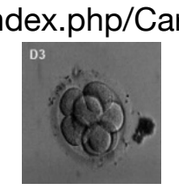
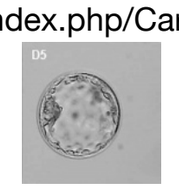
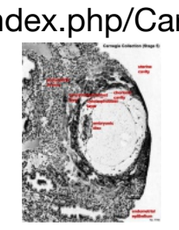
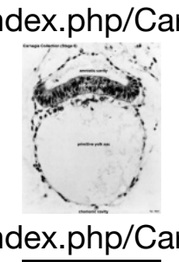
Historic Embryology (/embryology/index.php/Embryology_History) [Expand]

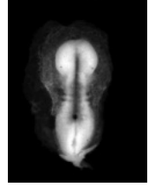
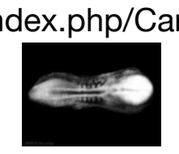
Next

- To see more details about 2nd and 3rd trimester development see Fetal Development (/embryology/index.php/Fetal_Development).
- To understand dynamic changes in structures see Movies (/embryology/index.php/Movies).
- The associated BGDA Practical 6 (/embryology/index.php/BGDA_Practical_-_Implantation_to_8_Weeks) class.

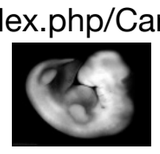
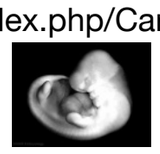
Carnegie Stage Table

Weeks shown in the table below are embryonic post ovulation age, for clinical Gestational Age (**GA** (/embryology/index.php/Gestational_Age)) measured from last menstrual period, add 2 weeks.

Stage	**Days** (approx)	**Size** (mm)	**Images** (not to scale)	Events
1 (/embryology/index.php/Carnegie_stage_1)	1 (**week 1** (/embryology/index.php/Week_1))	0.1 - 0.15	 (/embryology/index.php/Carnegie_stage_1)	fertilized oocyte, zygote (/embryology/index.php/Zygote), pronucle
2 (/embryology/index.php/Carnegie_stage_2)	2 - 3	0.1 - 0.2	 (/embryology/index.php/Carnegie_stage_2)	morula (/embryology/index.php/Morula) ce division with reduction in cytoplasmic volu blastocyst (/embryology/index.php/Blasto formation of inner and outer cell mass
3 (/embryology/index.php/Carnegie_stage_3)	4 - 5	0.1 - 0.2	 (/embryology/index.php/Carnegie_stage_3)	loss of zona pellucida, free blastocyst (/embryology/index.php/Blastocyst)
4 (/embryology/index.php/Carnegie_stage_4)	5 - 6	0.1 - 0.2	 (/embryology/index.php/Carnegie_stage_4)	attaching blastocyst (/embryology/index.php/Blastocyst)
5 (/embryology/index.php/Carnegie_stage_5)	7 - 12 (**week 2** (/embryology/index.php/Week_2))	0.1 - 0.2	 (/embryology/index.php/Carnegie_stage_5)	implantation (/embryology/index.php/Impl
6 (/embryology/index.php/Carnegie_stage_6)	13 - 15	0.2	 (/embryology/index.php/Carnegie_stage_6)	extraembryonic mesoderm, primitive strea gastrulation (/embryology/index.php/Gast
7 (/embryology/index.php/Carnegie_stage_7)	15 - 17 (**week 3** (/embryology/index.php/Week_3))	0.4	 (/embryology/index.php/Carnegie_stage_7)	gastrulation (/embryology/index.php/Gast notochordal process (/embryology/index.php/Notochord)
8 (/embryology/index.php/Carnegie_stage_8)	17 - 19	1.0 - 1.5	 (/embryology/index.php/Carnegie_stage_8)	primitive pit, notochordal canal
				Somitogenesis

9 (/embryology/index.php/Carnegie_stage_9)	19 - 21	1.5 - 2.5	 (/embryology/index.php/Carnegie_stage_9)	(/embryology/index.php/Somitogenesis) **S Number 1 - 3** neural folds, cardiac primor head fold
10 (/embryology/index.php/Carnegie_stage_10)	22 - 23 (**week 4** (/embryology/index.php/Week_4))	2 - 3.5	 (/embryology/index.php/Carnegie_stage_10)	**Somite Number 4 - 12** neural fold fuses
11 (/embryology/index.php/Carnegie_stage_11)	23 - 26	2.5 - 4.5	 (/embryology/index.php/Carnegie_stage_11)	**Somite Number 13 - 20** rostral neuropore
12 (/embryology/index.php/Carnegie_stage_12)	26 - 30	3 - 5	 (/embryology/index.php/Carnegie_stage_12)	**Somite Number 21 - 29** caudal neuropore
13 (/embryology/index.php/Carnegie_stage_13)	28 - 32 (**week 5** (/embryology/index.php/Week_5))	4 - 6	 (/embryology/index.php/Carnegie_stage_13)	**Somite Number 30** leg buds (/embryology/index.php/Musculoskeletal_ _Limb_Development), lens placode, phary arches

Stage 13/14 shown in serial embryo sections (/embryology/index.php/Carnegie_stage_13_-_serial_sections) series of Embryology Program

14 (/embryology/index.php/Carnegie_stage_14)	31 - 35	5 - 7	 (/embryology/index.php/Carnegie_stage_14)	lens pit, optic cup
15 (/embryology/index.php/Carnegie_stage_15)	35 - 38	7 - 9	 (/embryology/index.php/Carnegie_stage_15)	lens vesicle, nasal pit, hand plate (/embryology/index.php/Musculoskeletal_ _Limb_Development)
16 (/embryology/index.php/Carnegie_stage_16)	37 - 42 (**week 6** (/embryology/index.php/Week_6))	8 - 11	 (/embryology/index.php/File:Stage16_bf1c.jpg)	nasal pits moved ventrally, auricular hilloc plate
17 (/embryology/index.php/Carnegie_stage_17)	42 - 44	11 - 14	 (/embryology/index.php/Carnegie_stage_17)	finger rays
18 (/embryology/index.php/Carnegie_stage_18)	44 - 48 (**week 7** (/embryology/index.php/Week_7))	13 - 17	 (/embryology/index.php/Carnegie_stage_18)	ossification commences
19 (/embryology/index.php/Carnegie_stage_19)	48 - 51	16 - 18	 (/embryology/index.php/Carnegie_stage_19)	straightening of trunk
20 (/embryology/index.php/Carnegie_stage_20)	51 - 53 (**week 8** (/embryology/index.php/Week_8))	18 - 22	 (/embryology/index.php/Carnegie_stage_20)	upper limbs (/embryology/index.php/Musculoskeletal_ _Limb_Development) longer and bent at e
21 (/embryology/index.php/Carnegie_stage_21)	53 - 54	22 - 24	 (/embryology/index.php/Carnegie_stage_21)	hands and feet turned inward

Stage 22 shown in serial embryo sections series (/embryology/index.php/Carnegie_stage_22_-_serial_sections) of Embryology Program

22 (/embryology/index.php/Carnegie_stage_22)	54 - 56	23 - 28	 (/embryology/index.php/Carnegie_stage_22)	eyelids, external ears
23 (/embryology/index.php/Carnegie_stage_23)	56 - 60	27 - 31	 (/embryology/index.php/Carnegie_stage_23)	rounded head, body and limbs (/embryology/index.php/Musculoskeletal_ _Limb_Development)

Following this stage Fetal Development (/embryology/index.php/Fetal_Development) occurs until birth (approx 37 weeks)

The embryos shown in the table are from the Kyoto (/embryology/index.php/Kyoto_Collection) and Carnegie (/embryology/index.php/Carnegie_Collection) collection and other sources.

(/embryology/index.php/File:BGDsmall.jpg) **BGDA (/embryology/index.php/Medicine#BGD_Cycle_A):** Lecture 1 (/embryology/index.php/BGDA_Lecture_-_Development_of_the_Embryo/Fetus_1) | **Lecture 2** | Practical 3 (/embryology/index.php/BGDA_Practical_-_Fertilization_to_Implantation) | Practical 6 (/embryology/index.php/BGDA_Practical_-_Implantation_to_8_Weeks) | Practical 12 (/embryology/index.php/BGDA_Practical_-_Fetal_Development) | Lecture Neural (/embryology/index.php/BGDA_Lecture_-_Development_of_the_Nervous_System) | Practical 14 (/embryology/index.php/BGDA_Practical_-_Placenta_and_Fetal_Membranes) | *Histology Support* - Female (/embryology/index.php/BGDA_Practical_-_Female_Reproductive_Tract_Histology) | Male (/embryology/index.php/BGDA_Practical_-_Male_Reproductive_Tract_Histology) | Tutorial (/embryology/index.php/BGDA_Tutorial_-_Embryology)

Glossary Links

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