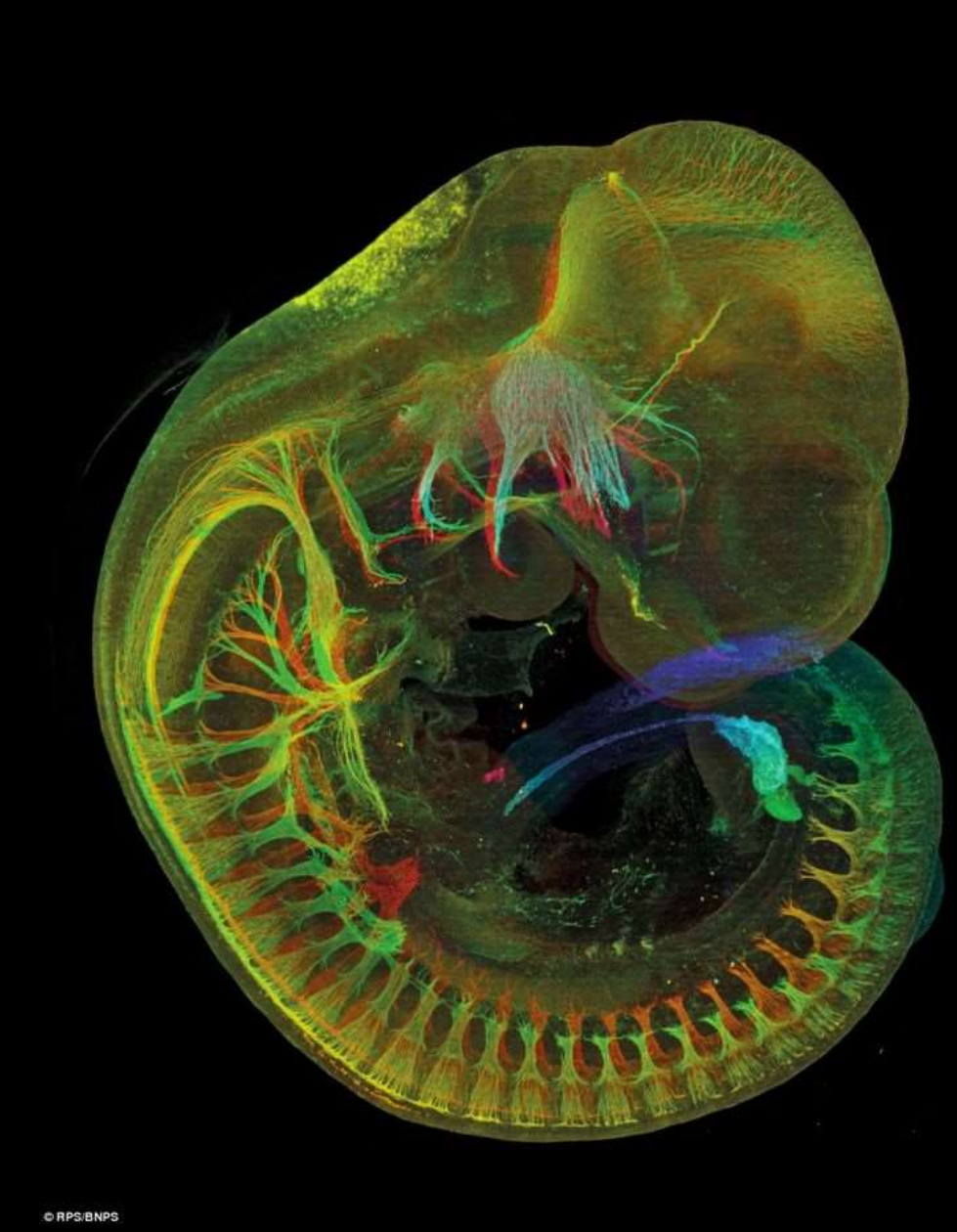


Introduction to embryology III

Petr Vaňhara, PhD., UHE LF MU

FIRST EVENTS IN HUMAN LIFE

Fertilization

START! 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21

Cleavage

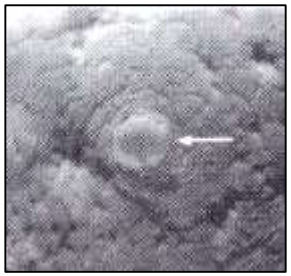
Blastogenesis

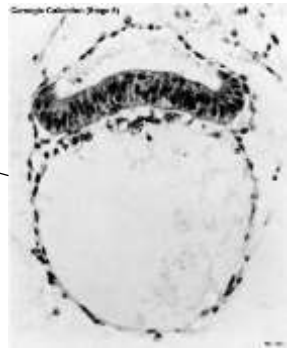
1st week

Embryogenesis

Implantation

- Adhesion of blastocyst
- Differentiation of trofoblast
- End of implantation





2nd week

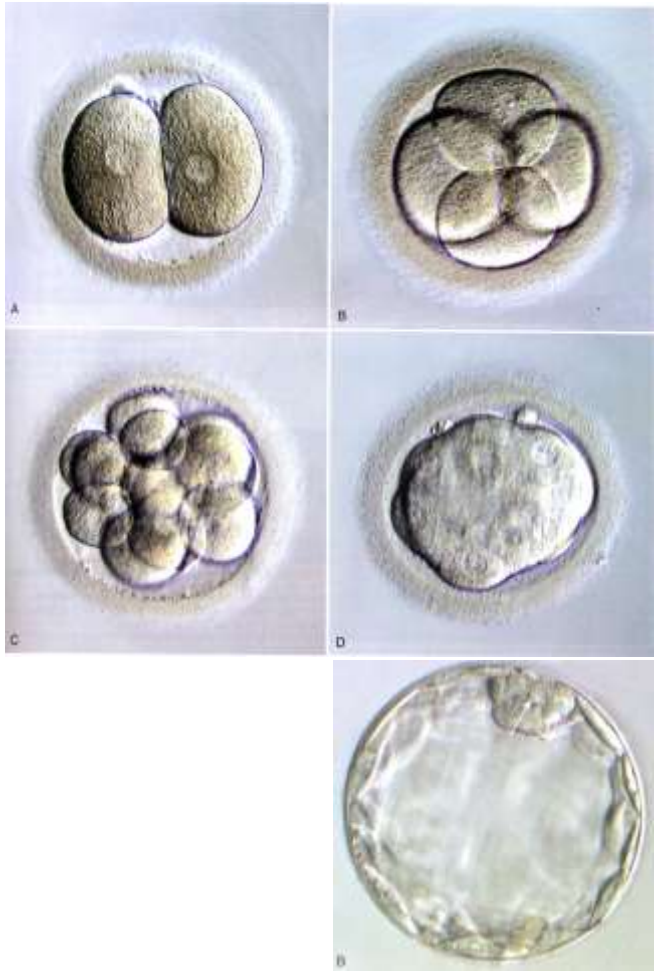
- Differentiation of embryoblast
- **Bilaminar germ disc**
- Amniotic cavity
- Primary yolk sac
- Extraembryonic mesoderm

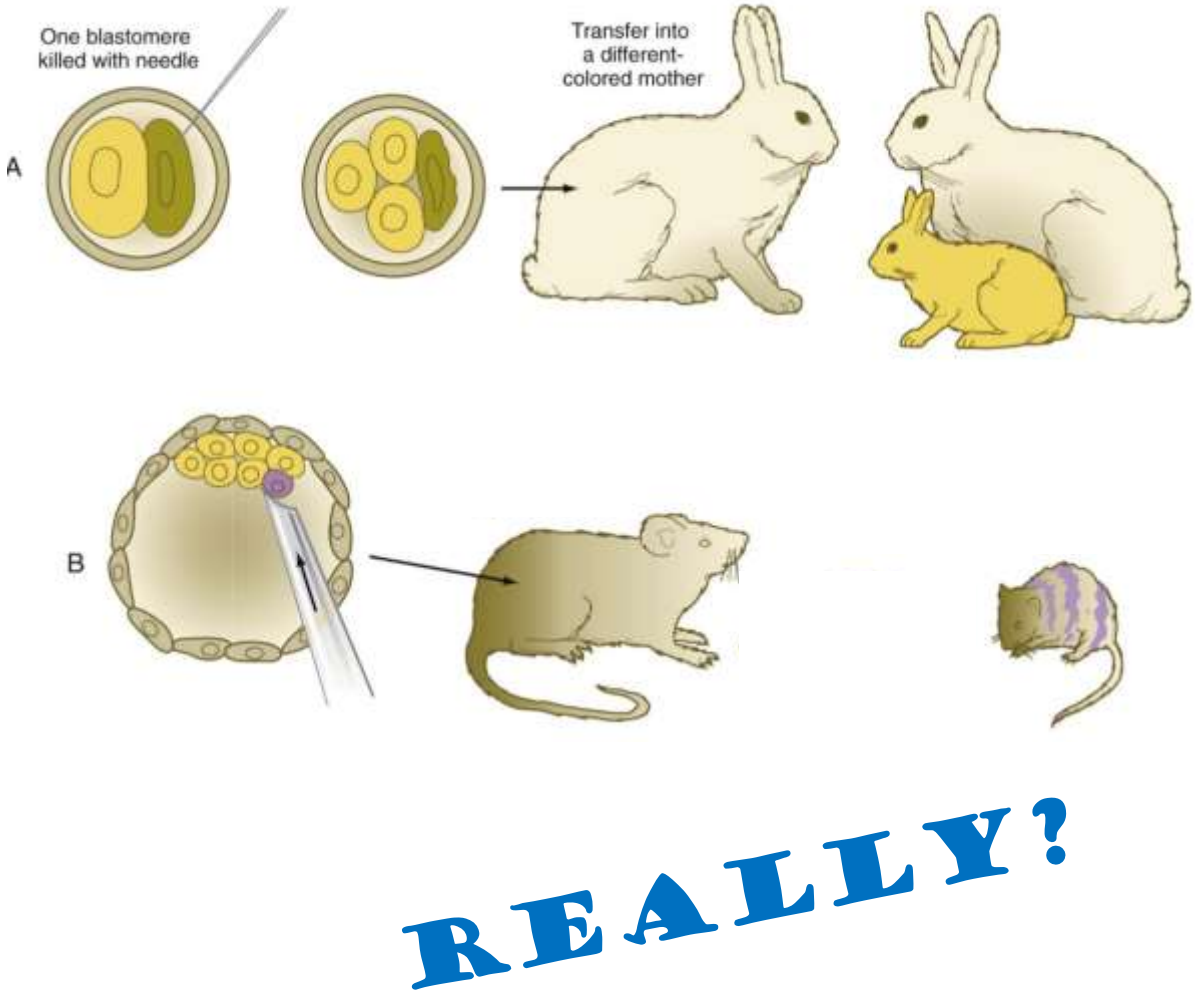
3rd week

- **Trilaminar germ diskc**
- Differentiation of epiblast
- Primitive node and primitive streak
- Differentiation of mesoderm
- Differentiation of ectoderm and neuroectoderm
- Somitogenesis

1st week

WHAT IS DEVELOPMENTAL POTENTIAL OF BLASTOMERES?



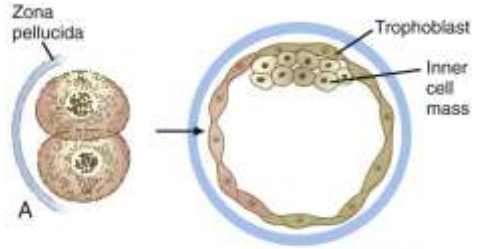


REALLY?

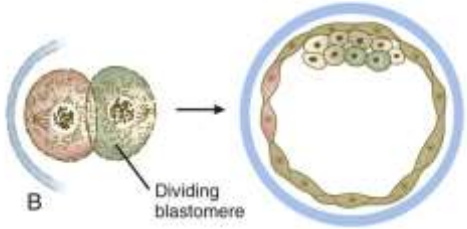
Conclusion: all blastomeres are equal.

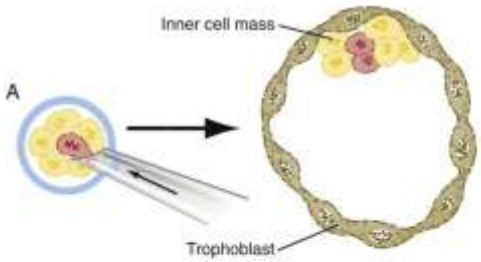
1st week

Mechanism of diferentiation

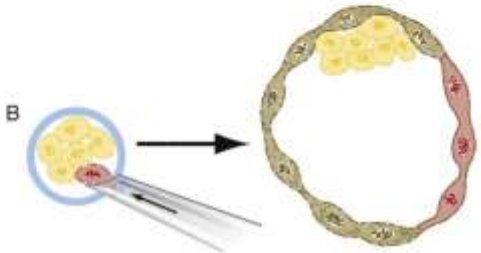


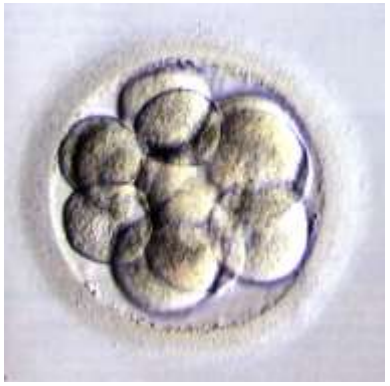
„cell polarity“





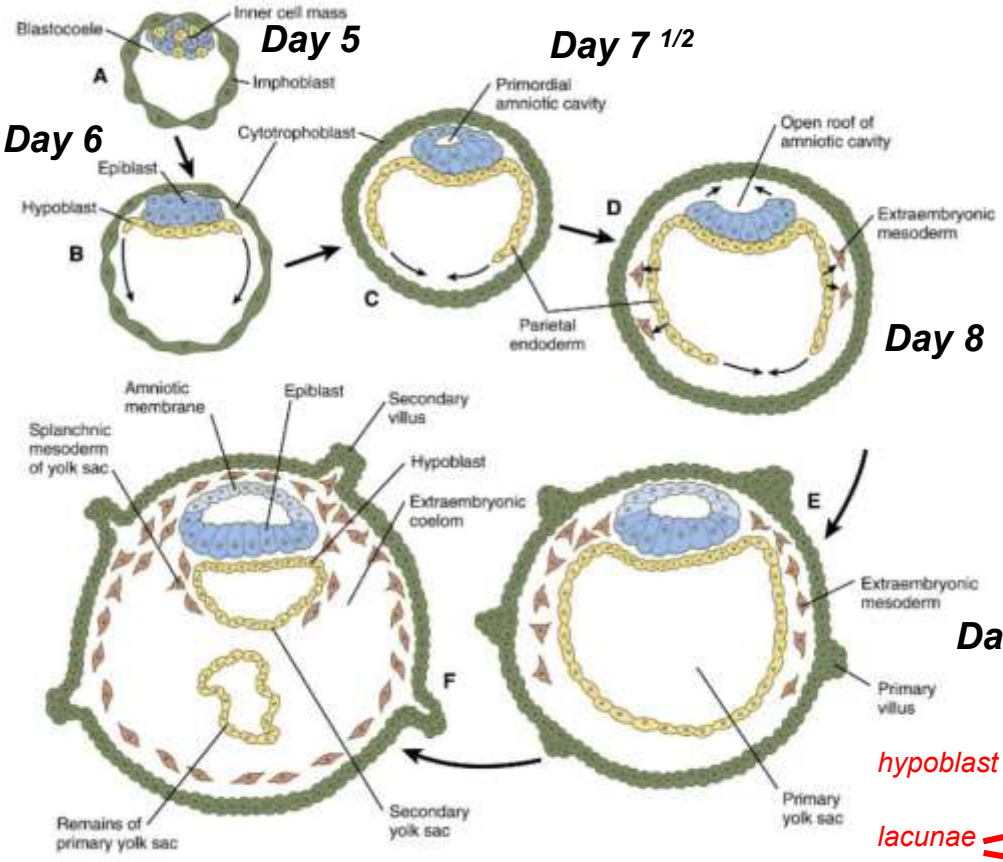
„inside-outside“



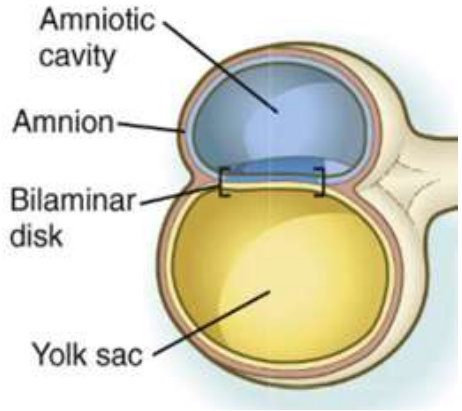


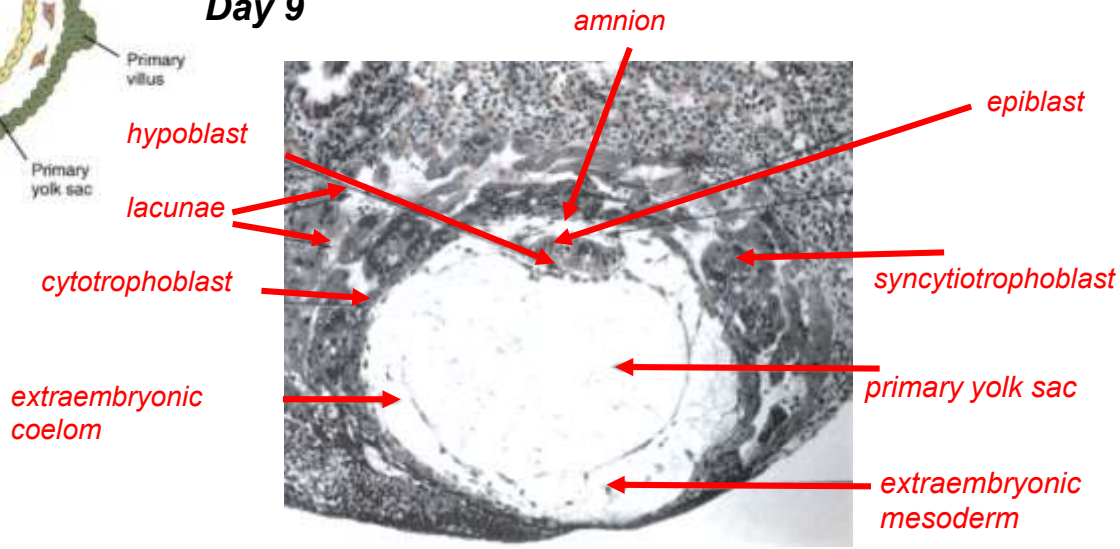
- 16-cell embryo is still totipotent – later (32-cell), it loses the full developmental potential → cell are **determined.**

1st-2nd week BILAMINAR GERM DISC

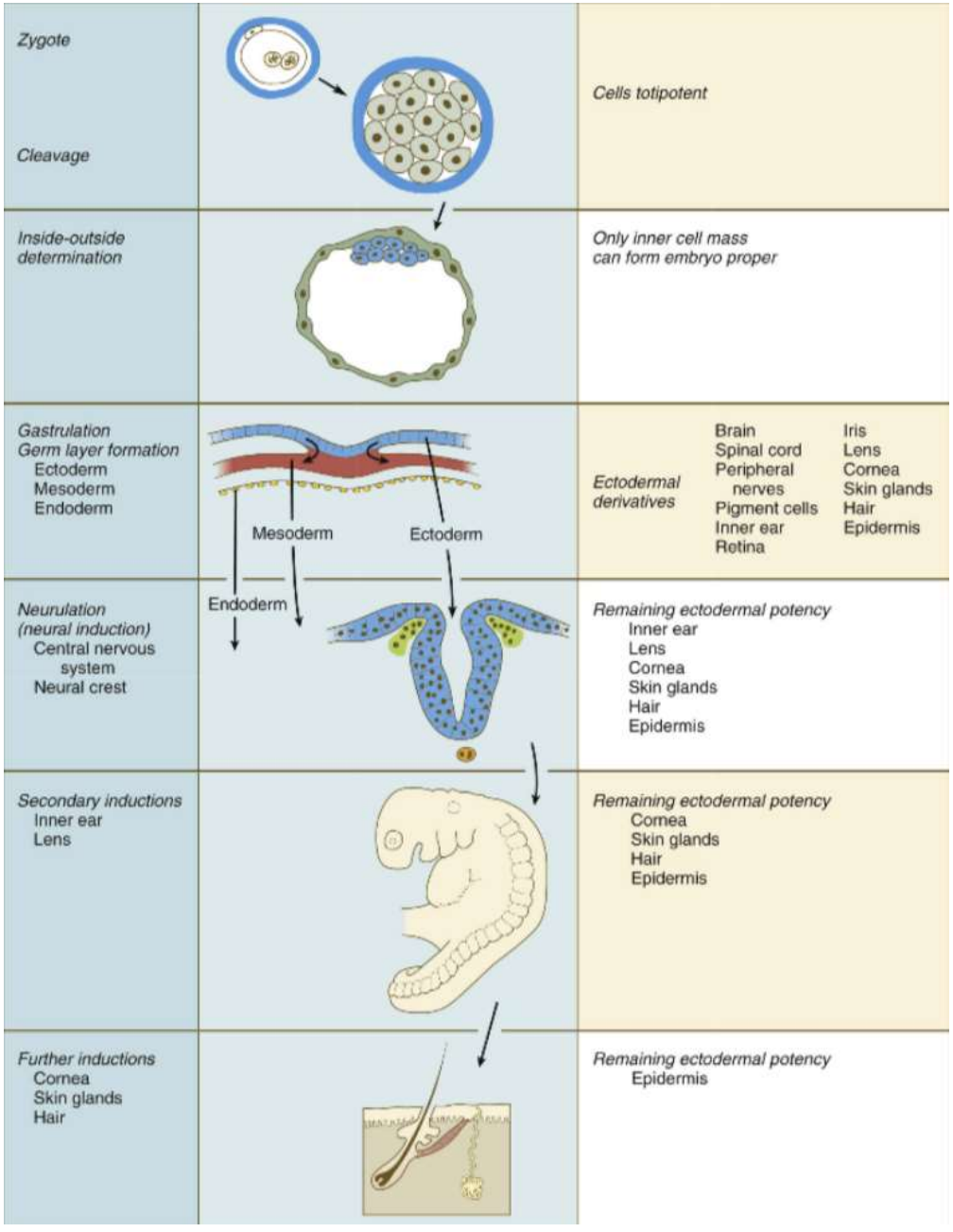


end of 2nd week

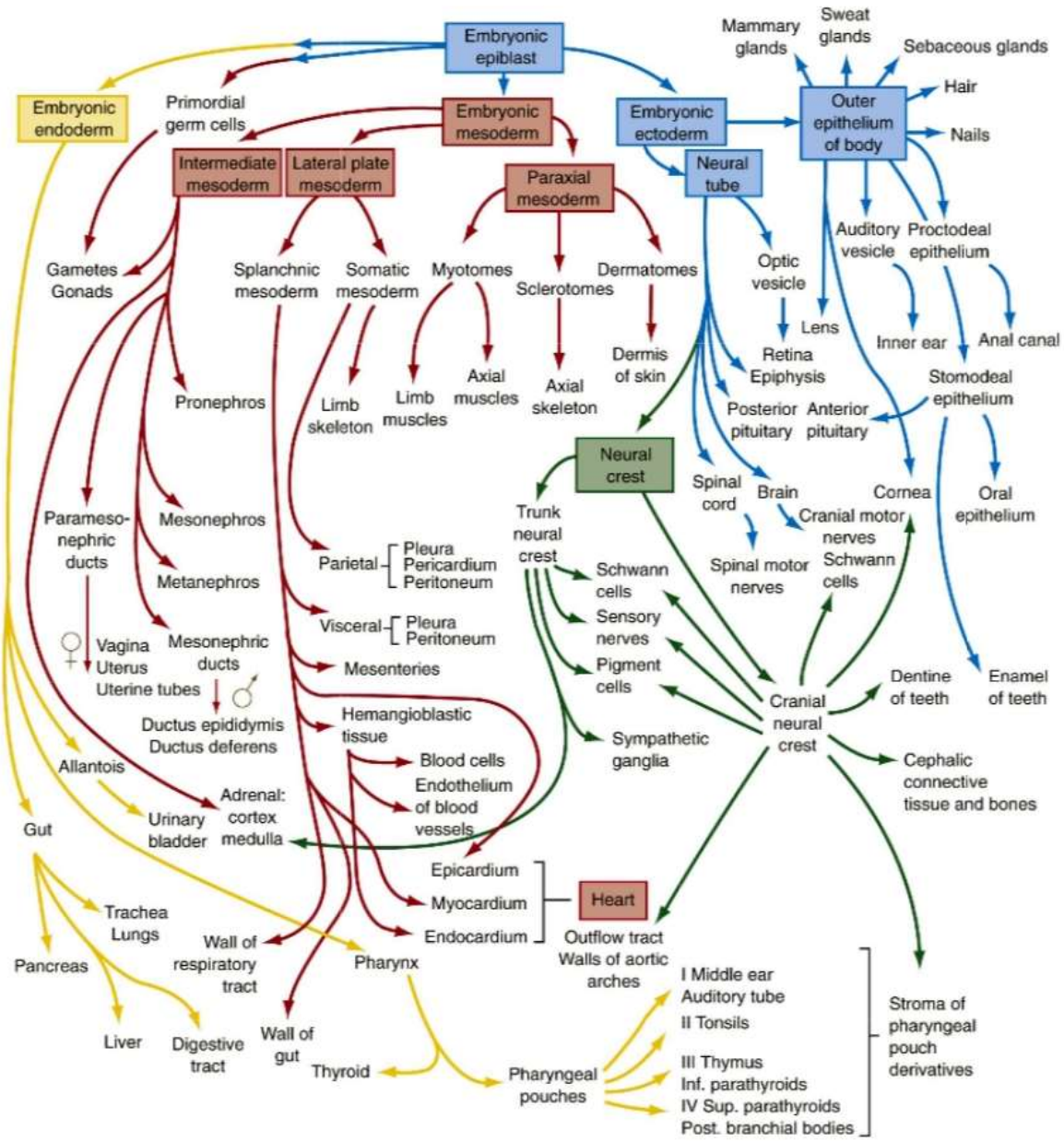




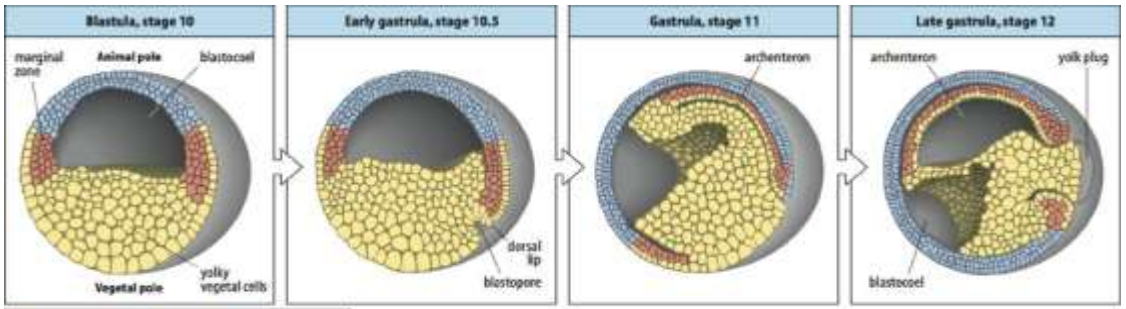
EMBRYONIC INDUCTION AND DETERMINATION



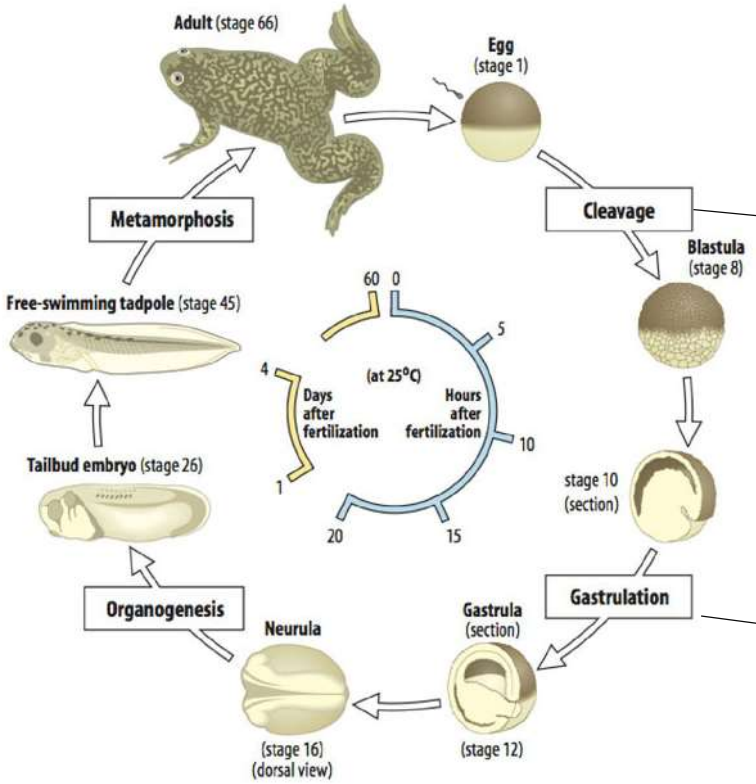
EMBRYONIC INDUCTION AND DETERMINATION DRIVE DEVELOPMENT OF TISSUES AND ORGANS

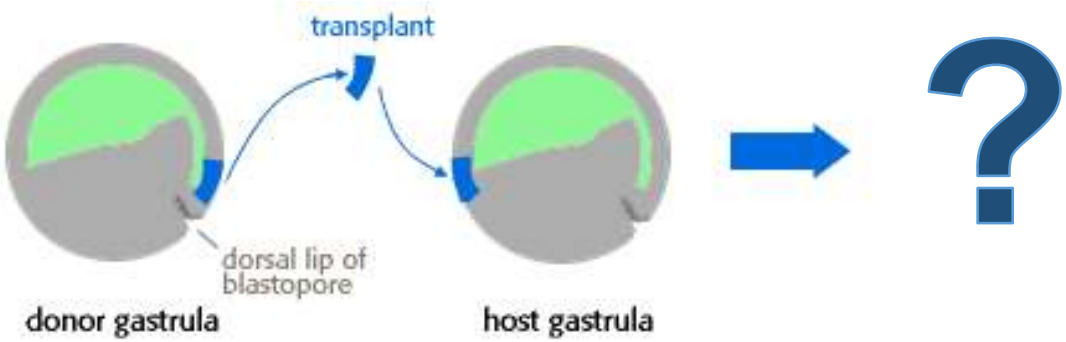


BREAKTHROUGH EXPERIMENT OF HANS SPEMANN AND HILDE MANGOLD 1923



BREAKTHROUGH EXPERIMENT OF HANS SPEMANN AND HILDE MANGOLD





What they got?

BREAKTHROUGH EXPERIMENT OF HANS SPEMANN AND HILDE MANGOLD

Induction of Embryonic Primordia by Implantation of Organizers from a Different Species

by

HANS SPEMANN and HILDE MANGOLD *(Née Pröscholdt)*

Freiburg i.B.

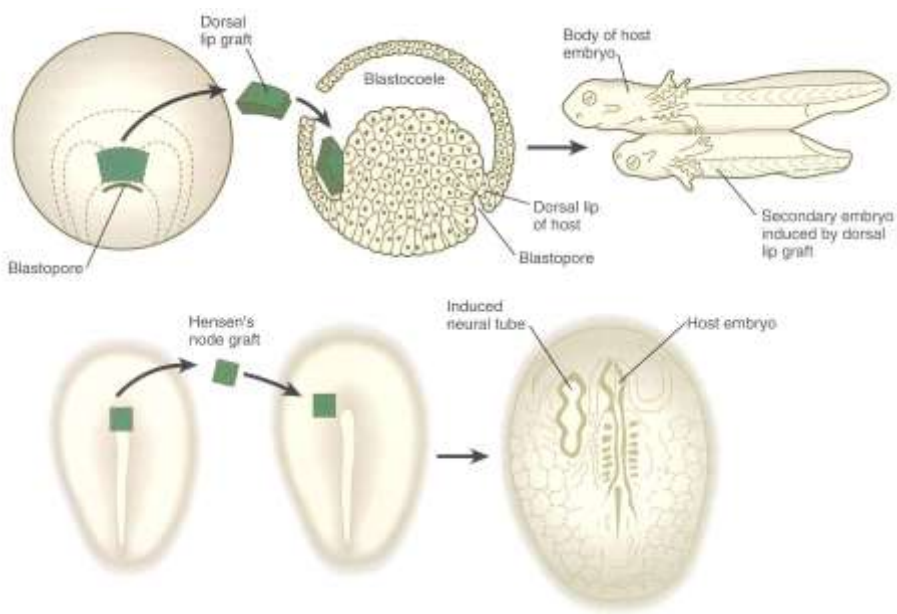
With 25 illustrations

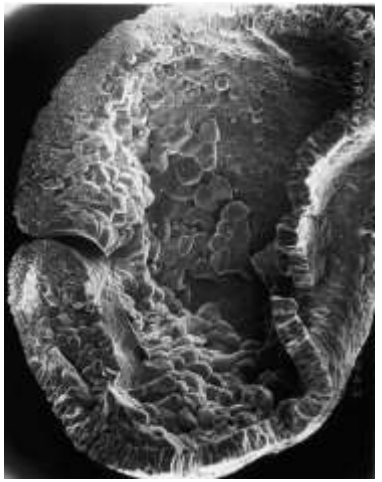
(Submitted 1 June 1923)

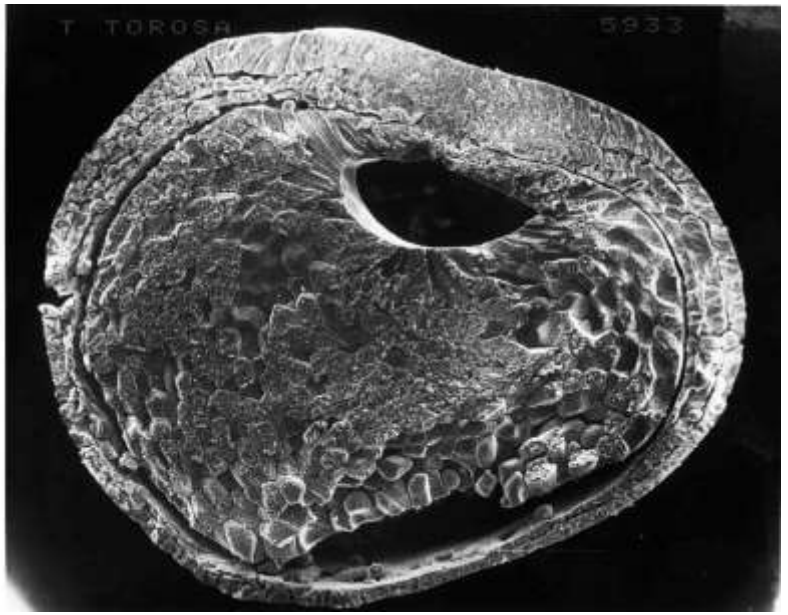
„A piece of upper blastopore lip of an amphibian embryo undergoing gastrulation exerts an organizing effect on its environment in such a way that, if transplanted to an indiferent region of another embryo, it causes there the formation of a secondary embryonic anlage. Such a piece can therefore be designated as an Organizer.“

SPEMANN'S ORGANIZER

PRINCIPLE OF EMBRYONIC INDUCTION



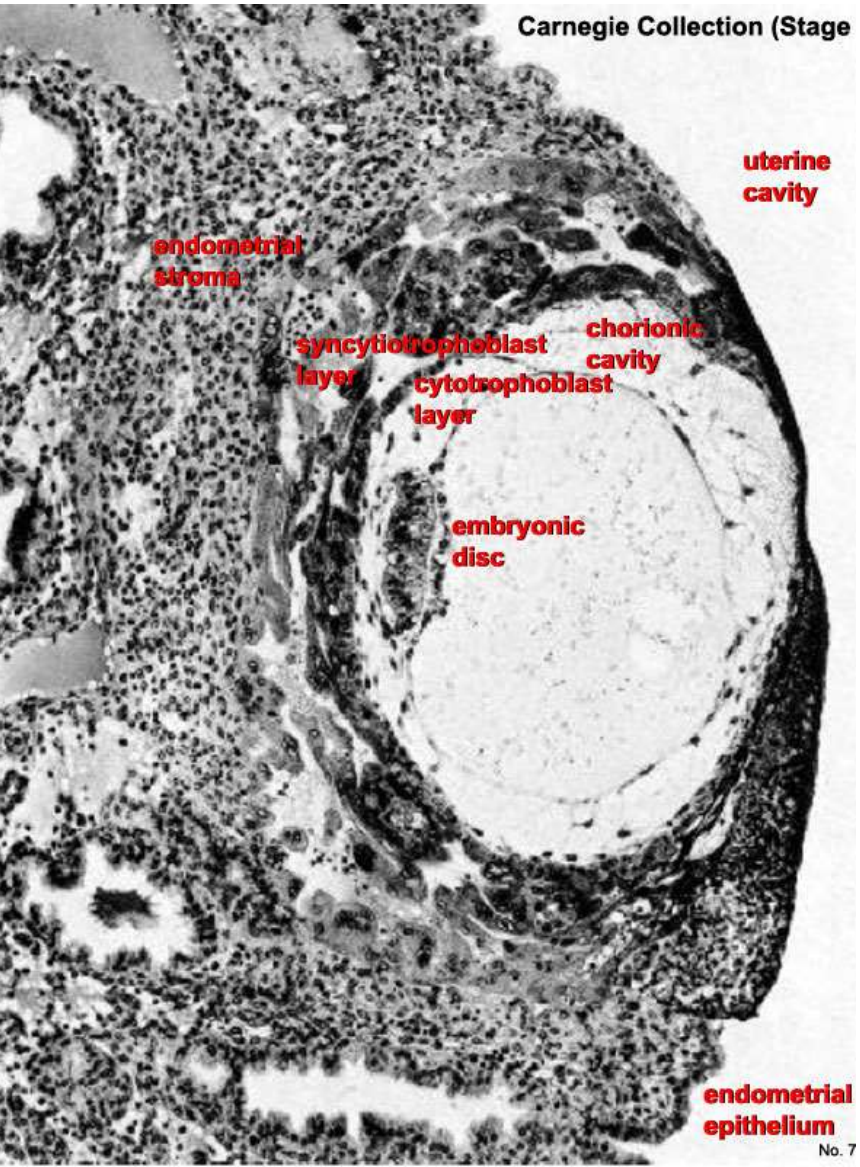


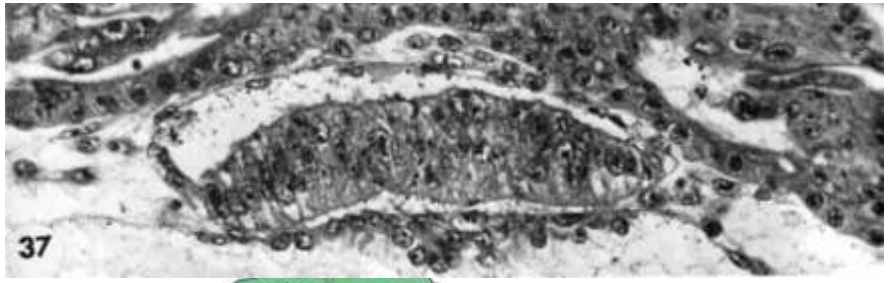


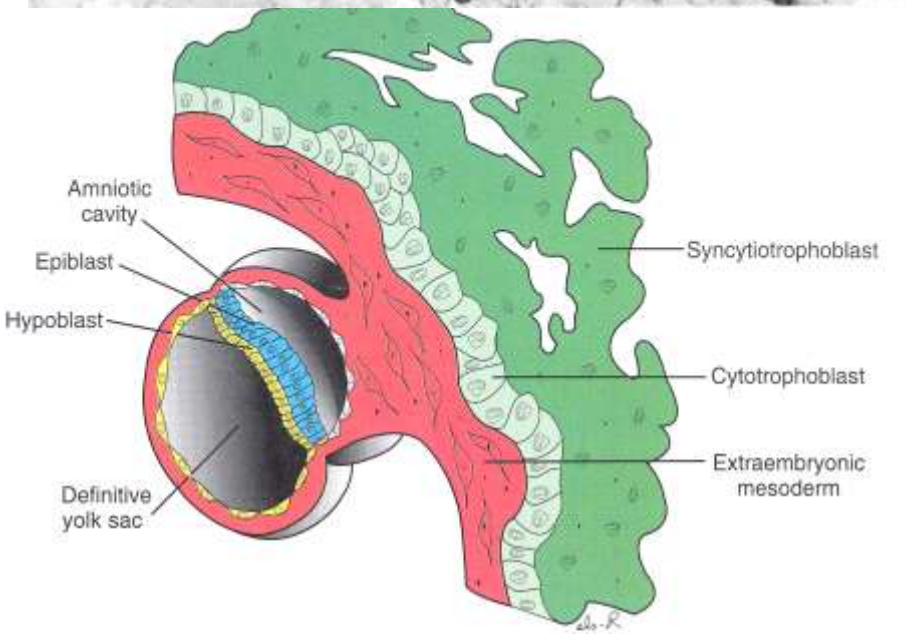
ORGANIZER EXISTS IN MAMMALLS

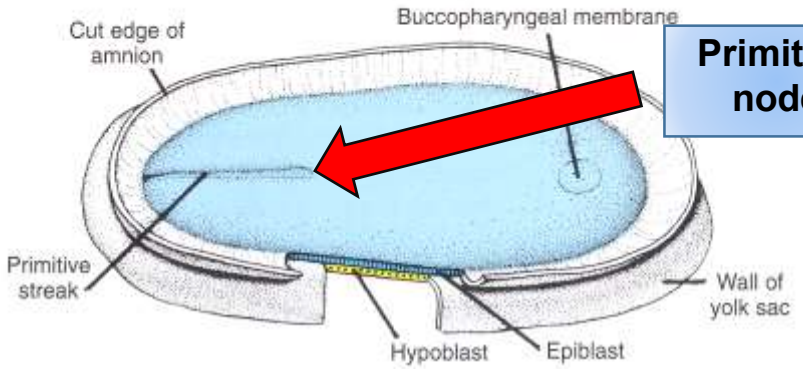
BILAMINAR GERM DISC

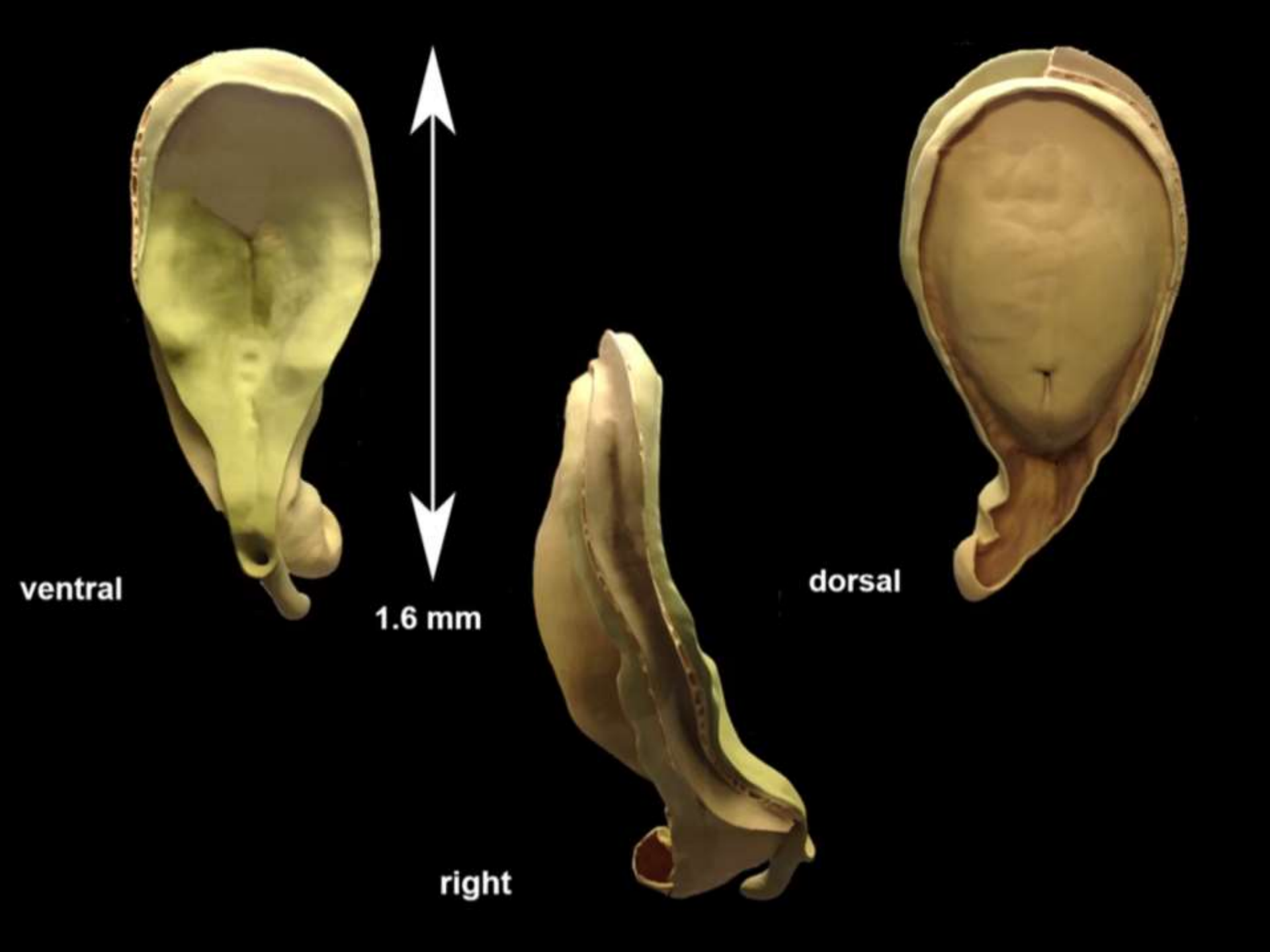
2nd week







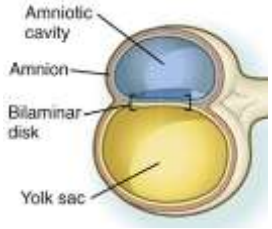



ventral
1.6 mm
dorsal
right

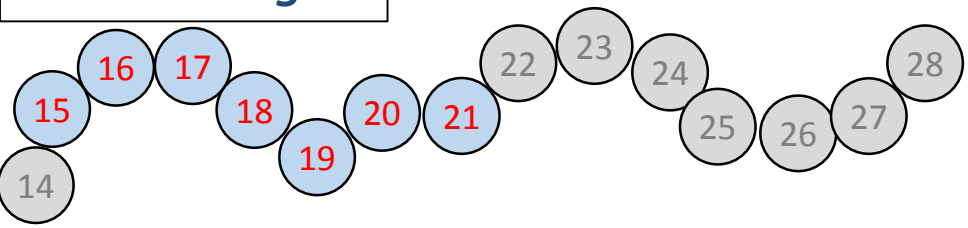
TRILAMINAR GERM DISC

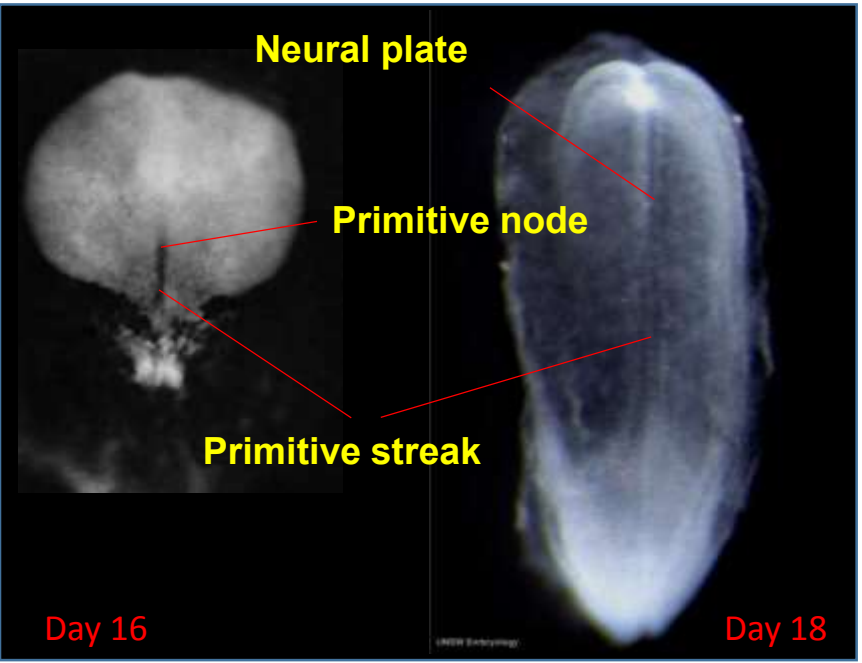
PRIMITIVE STREAK AND PRIMITIVE NODE

2nd week *ends*

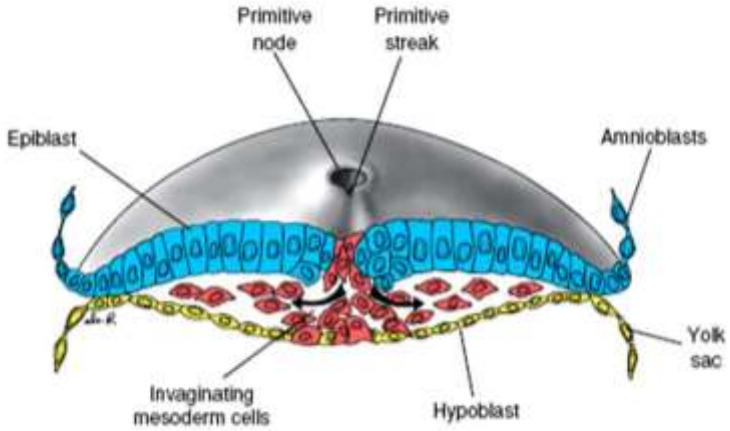


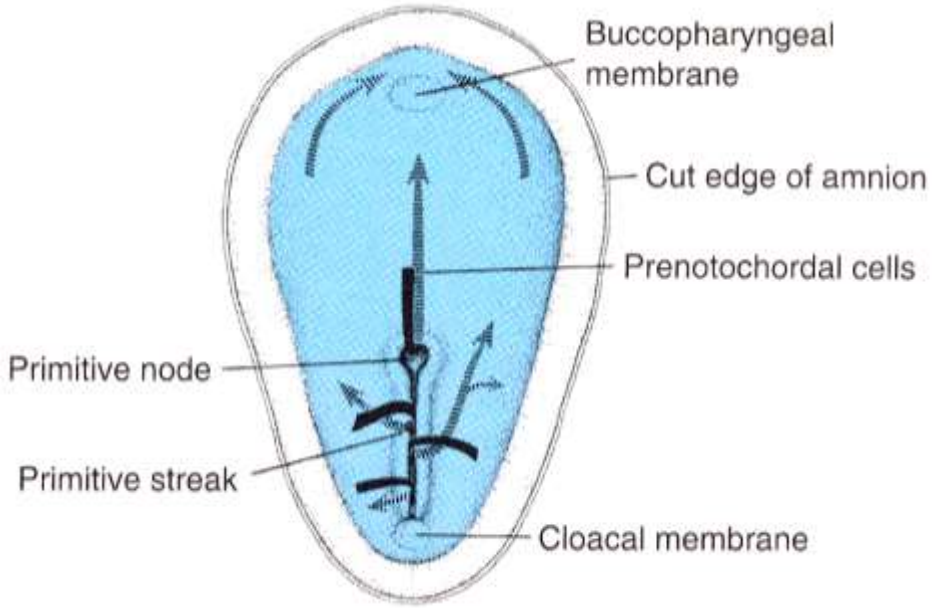
3rd week *begins*





NEW STRUCTURES

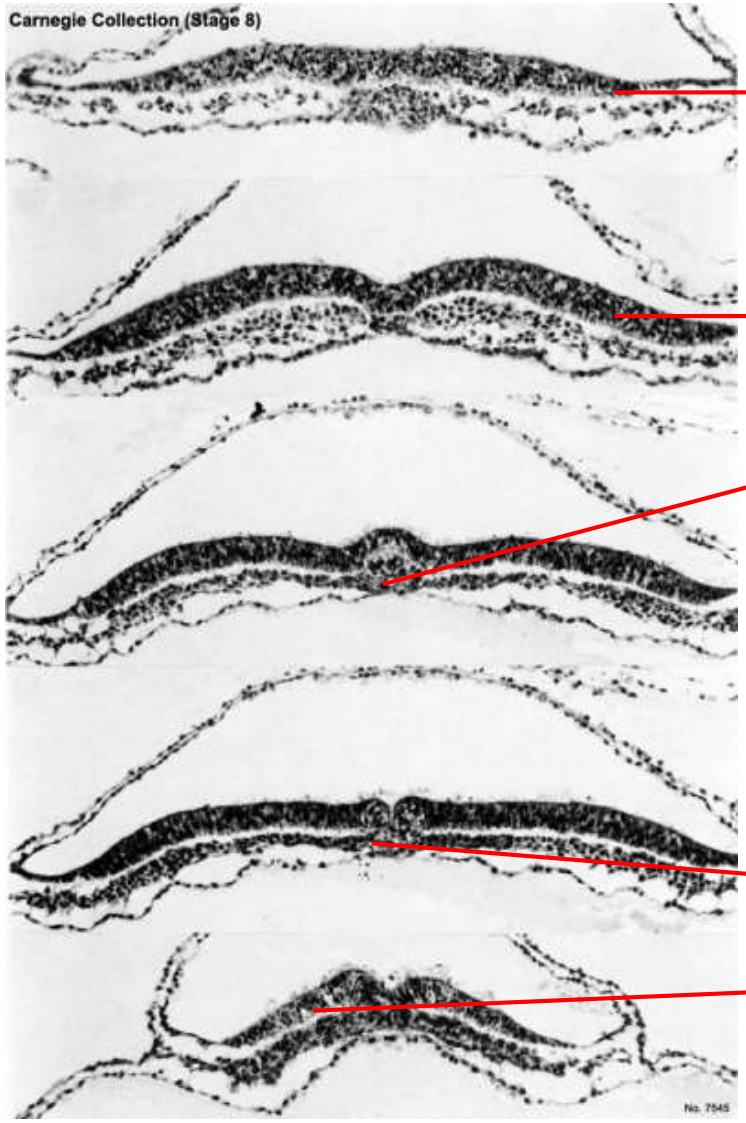




TRILAMINAR GERM DISC

PRIMITIVE STREAK AND PRIMITIVE NODE

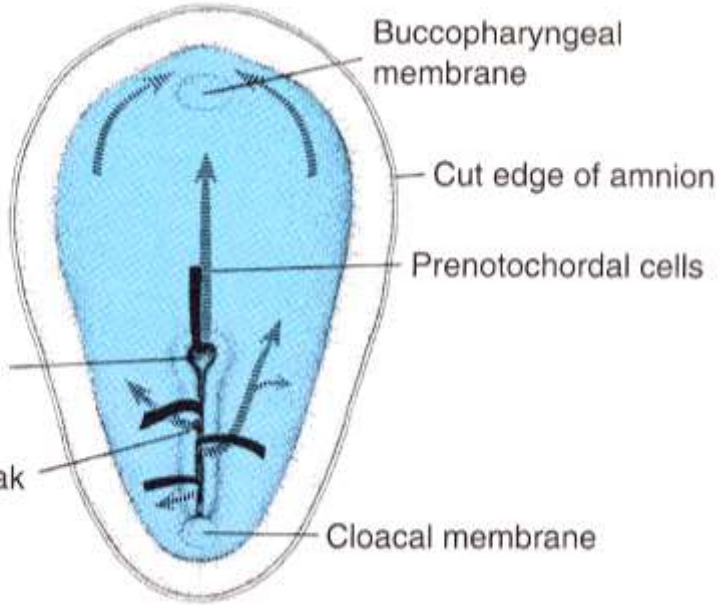
3rd week



Prechordal plate

Neural plate

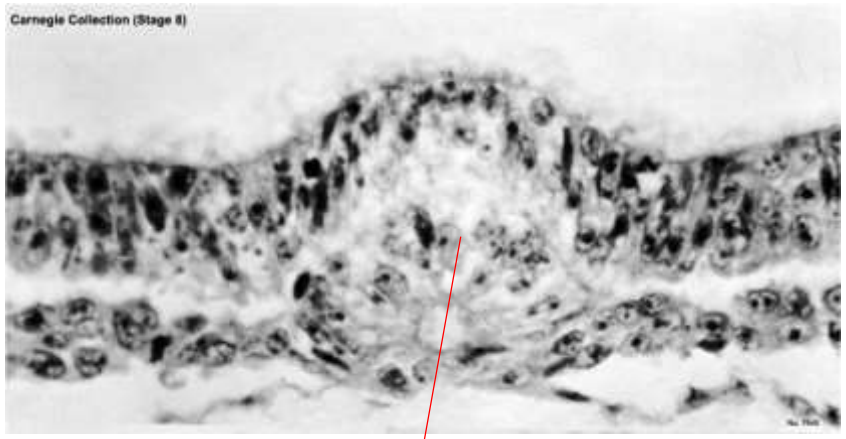
Notochordal process

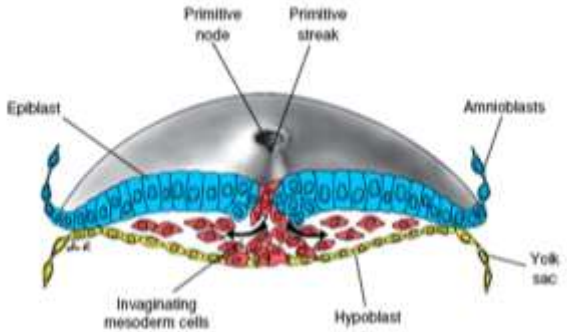


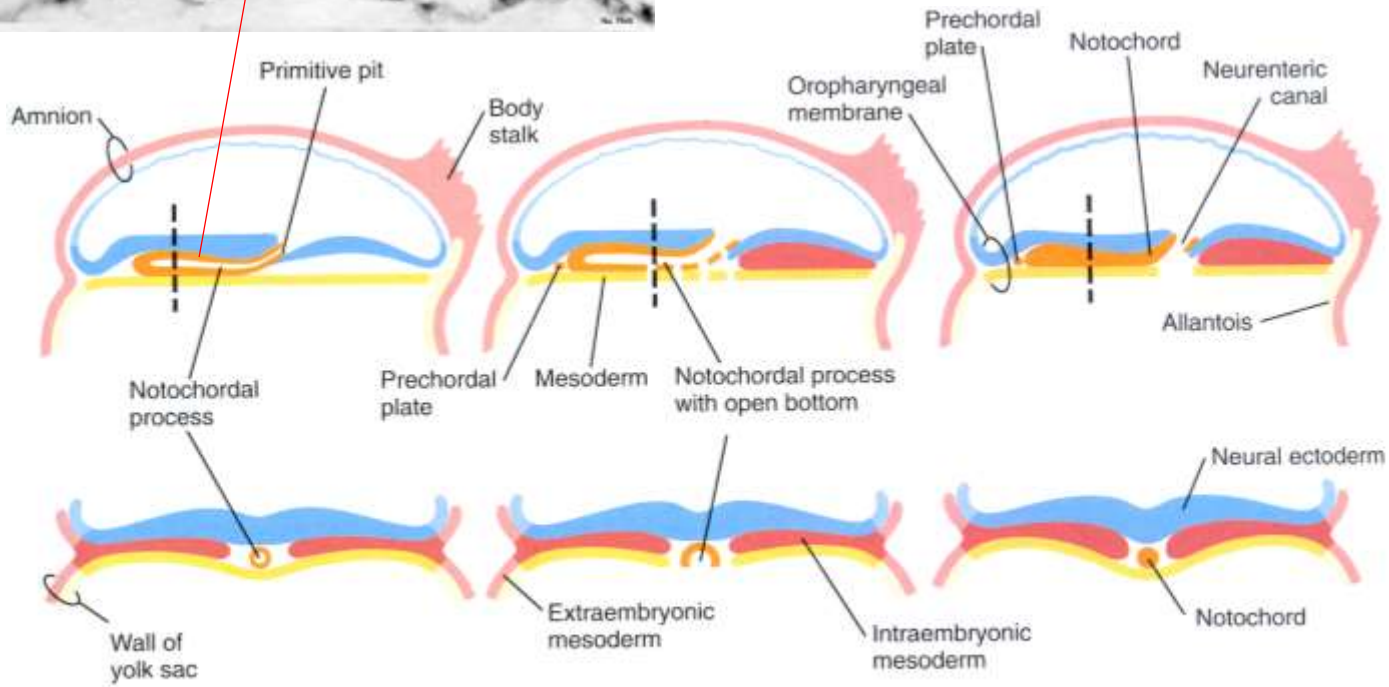
TRILAMINAR GERM DISC

PRIMITIVE STREAK AND PRIMITIVE NODE

3rd week





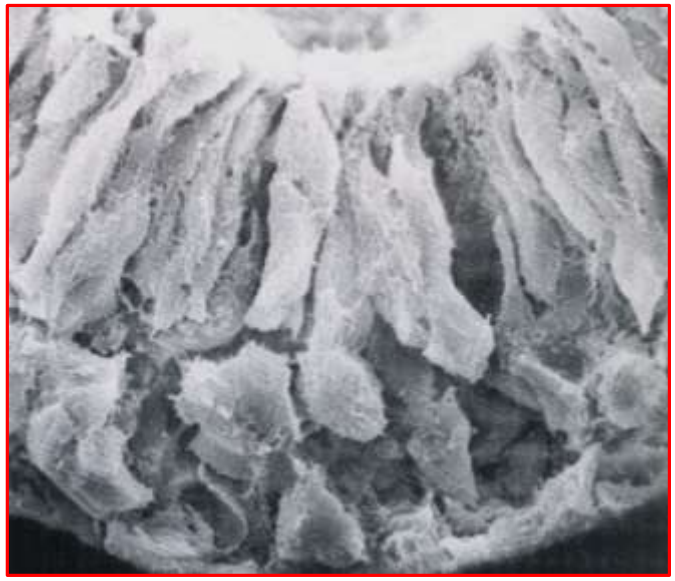


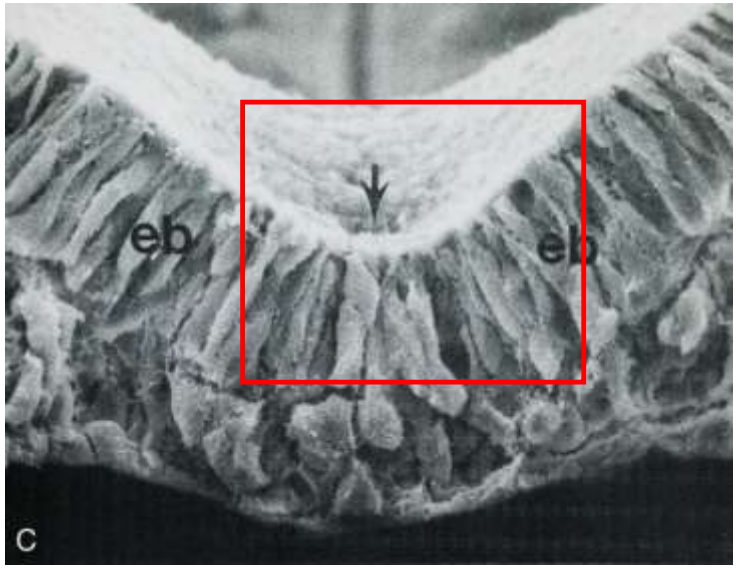
Day 17 Day 18 Day 19

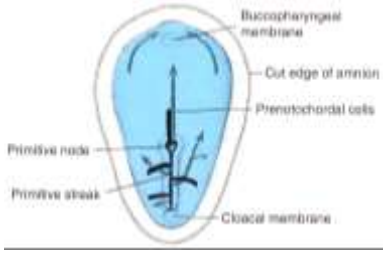
TRILAMINAR GERM DISC

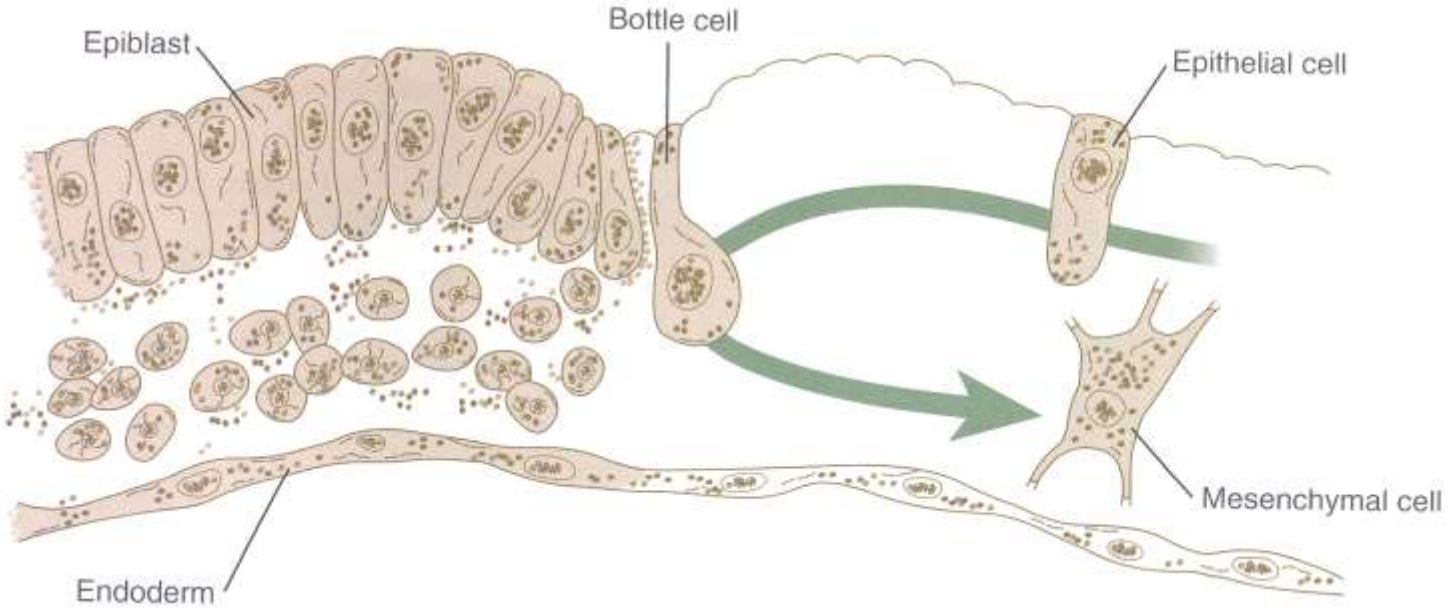
PRIMITIVE STREAK AND PRIMITIVE NODE

3rd week





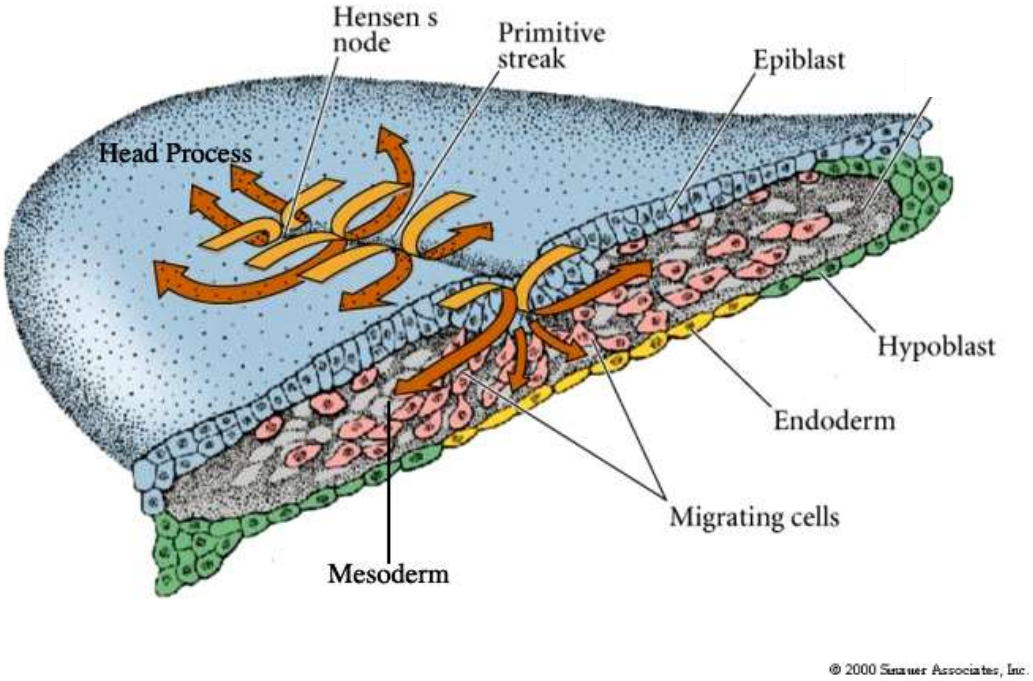


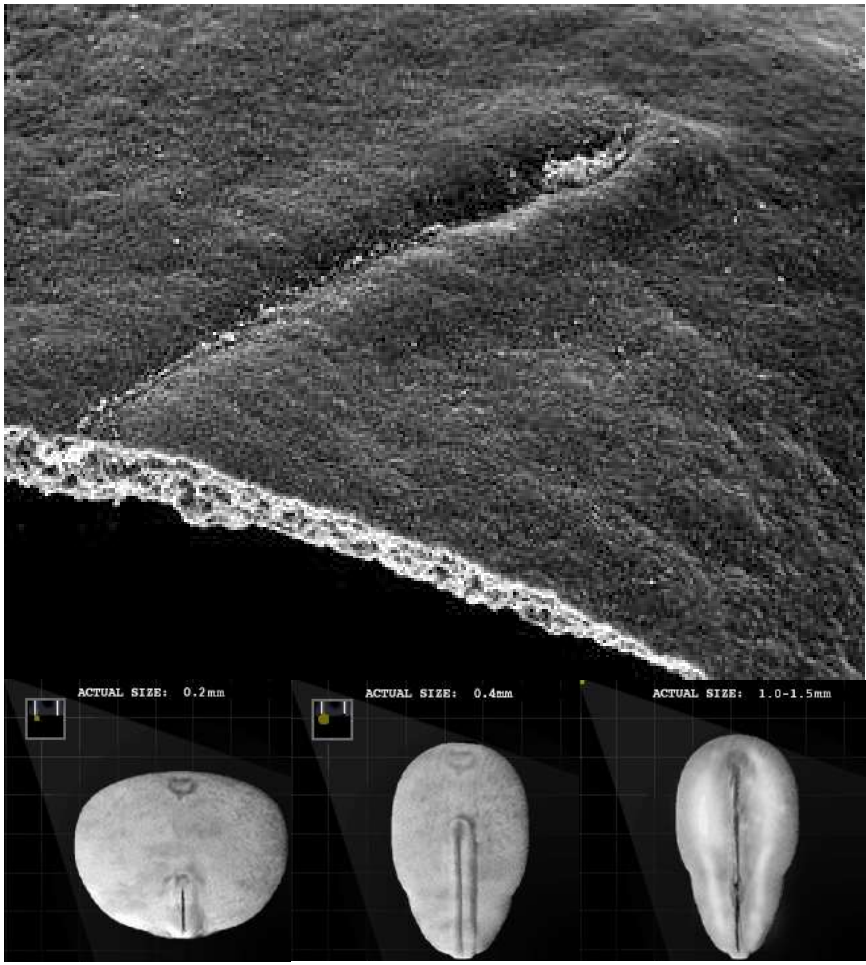


TRILAMINAR GERM DISC

PRIMITIVE STREAK AND PRIMITIVE NODE

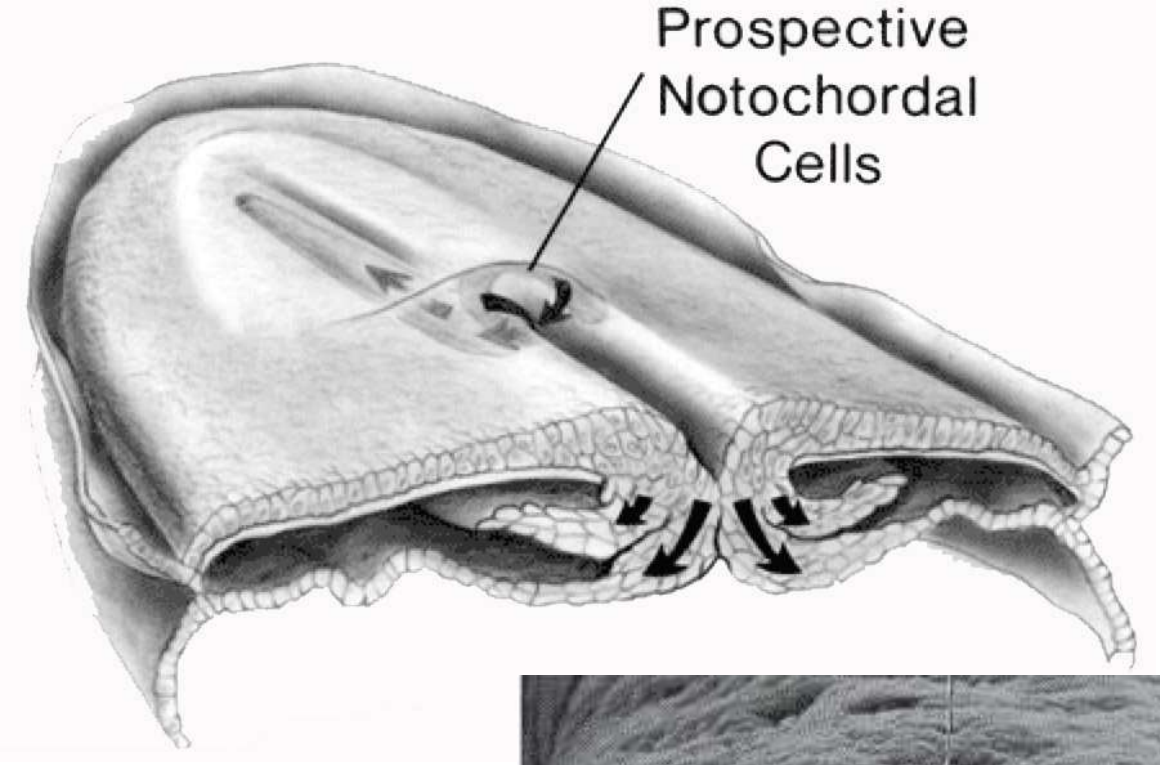
3rd week





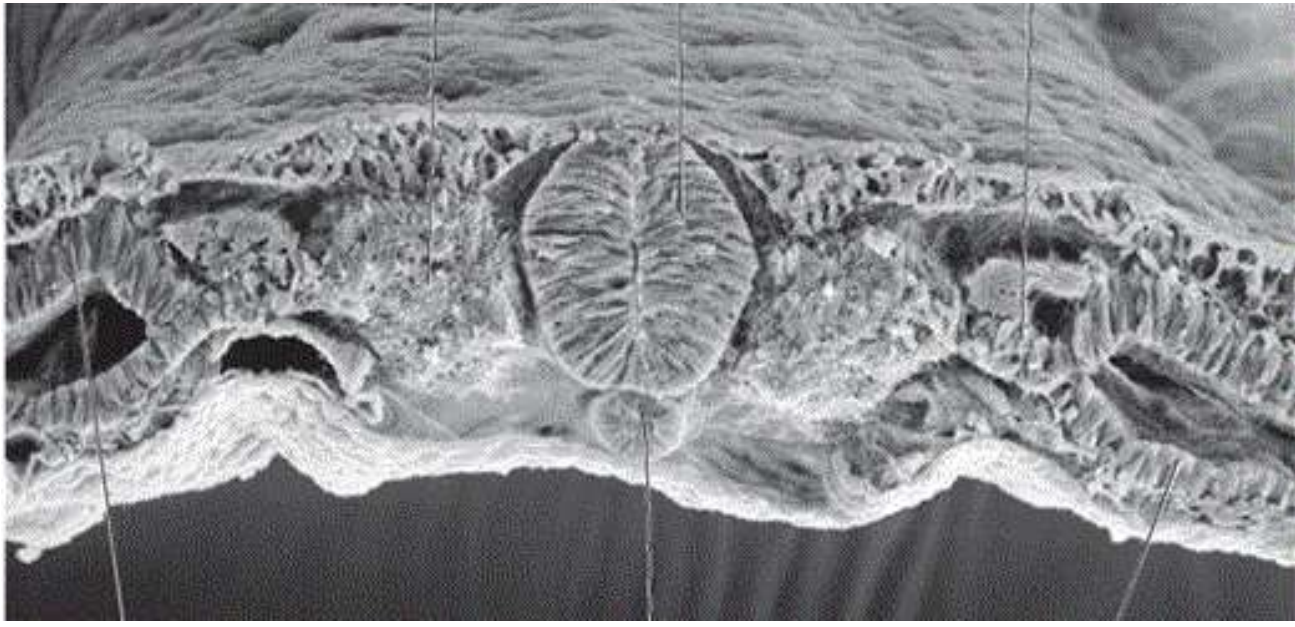
A new cell population appears - MESODERM

NOTOCHORD

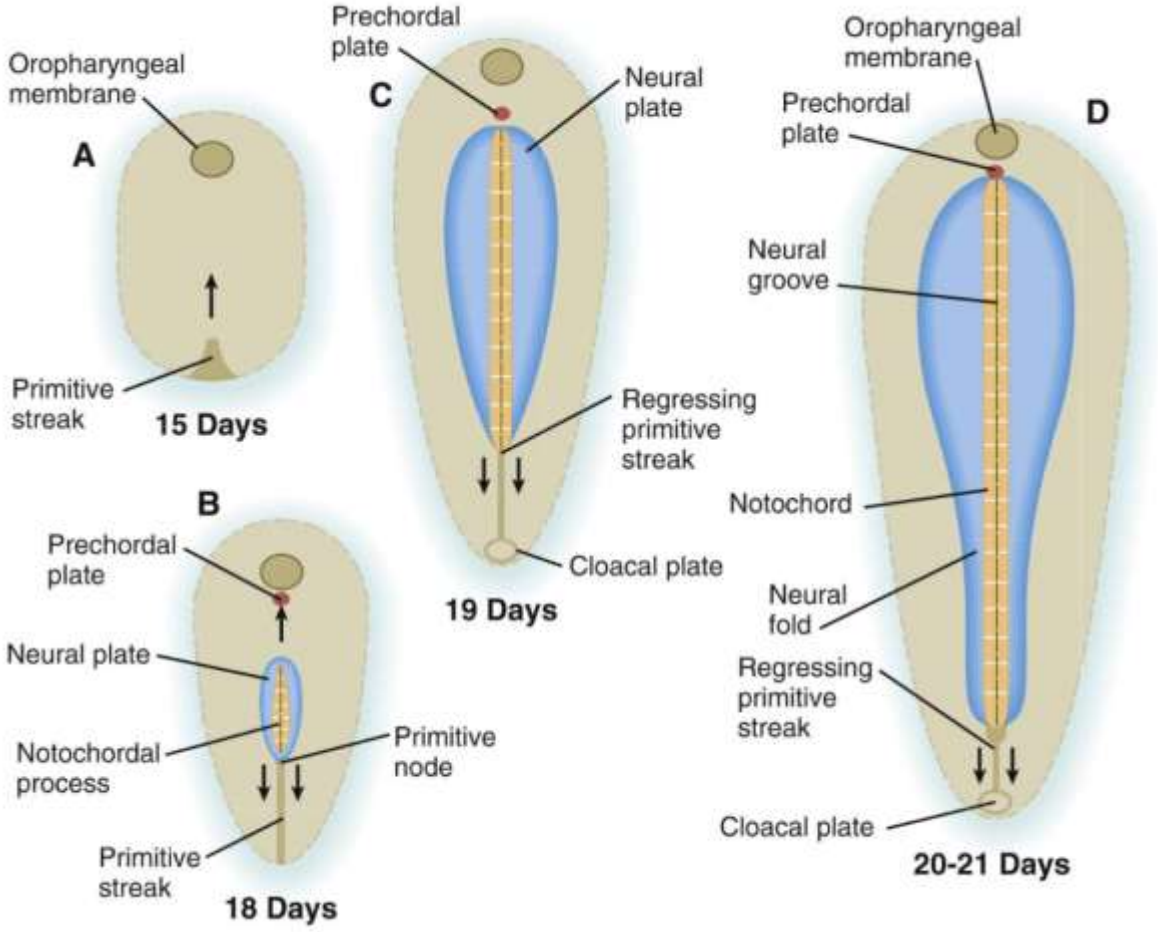


End of 2nd week

End of 3rd week

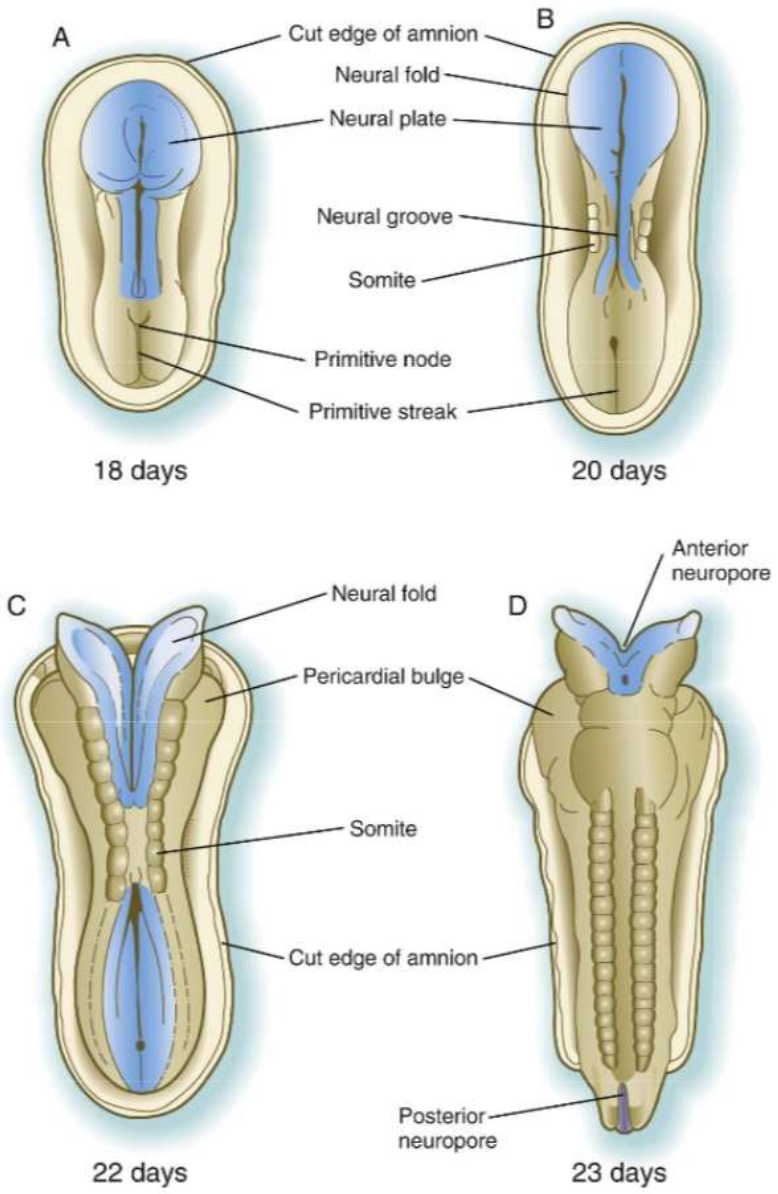


3rd week



Notochord induces differentiation of ectoderm – cellular basis of nerve system is established – **NEUROECTODERM**

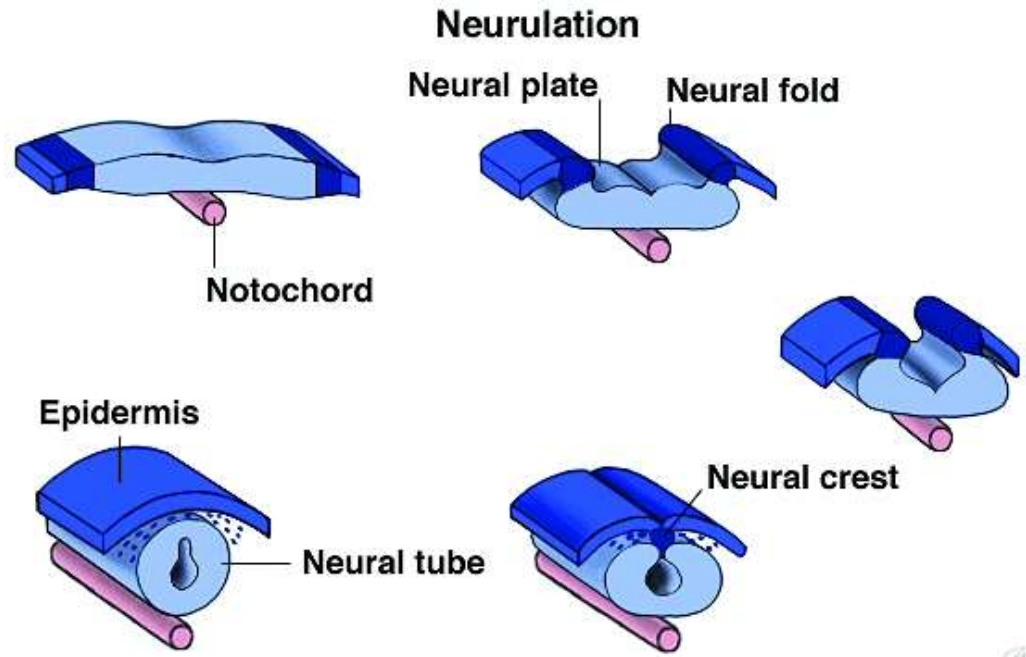
3rd week

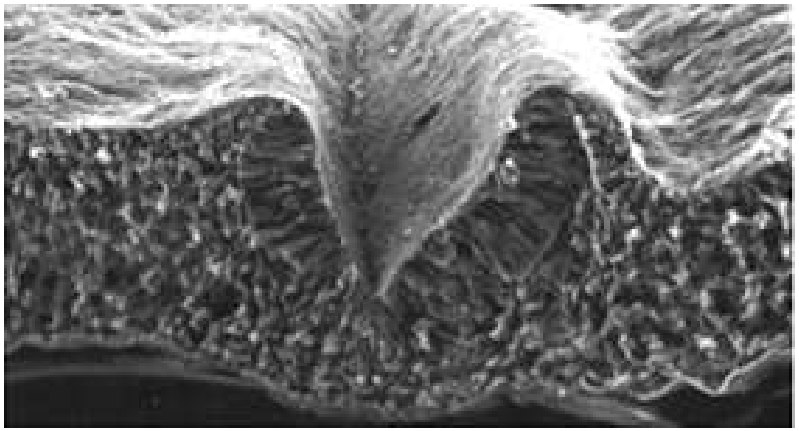


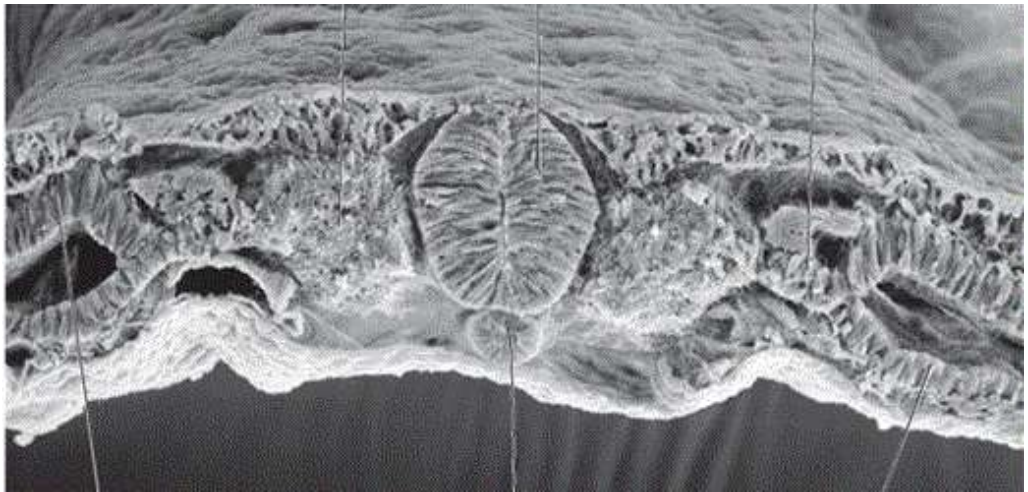
- **Neural plate**
- **Neural folds**
- **Neural tube**

- **Neural crest**

3rd week



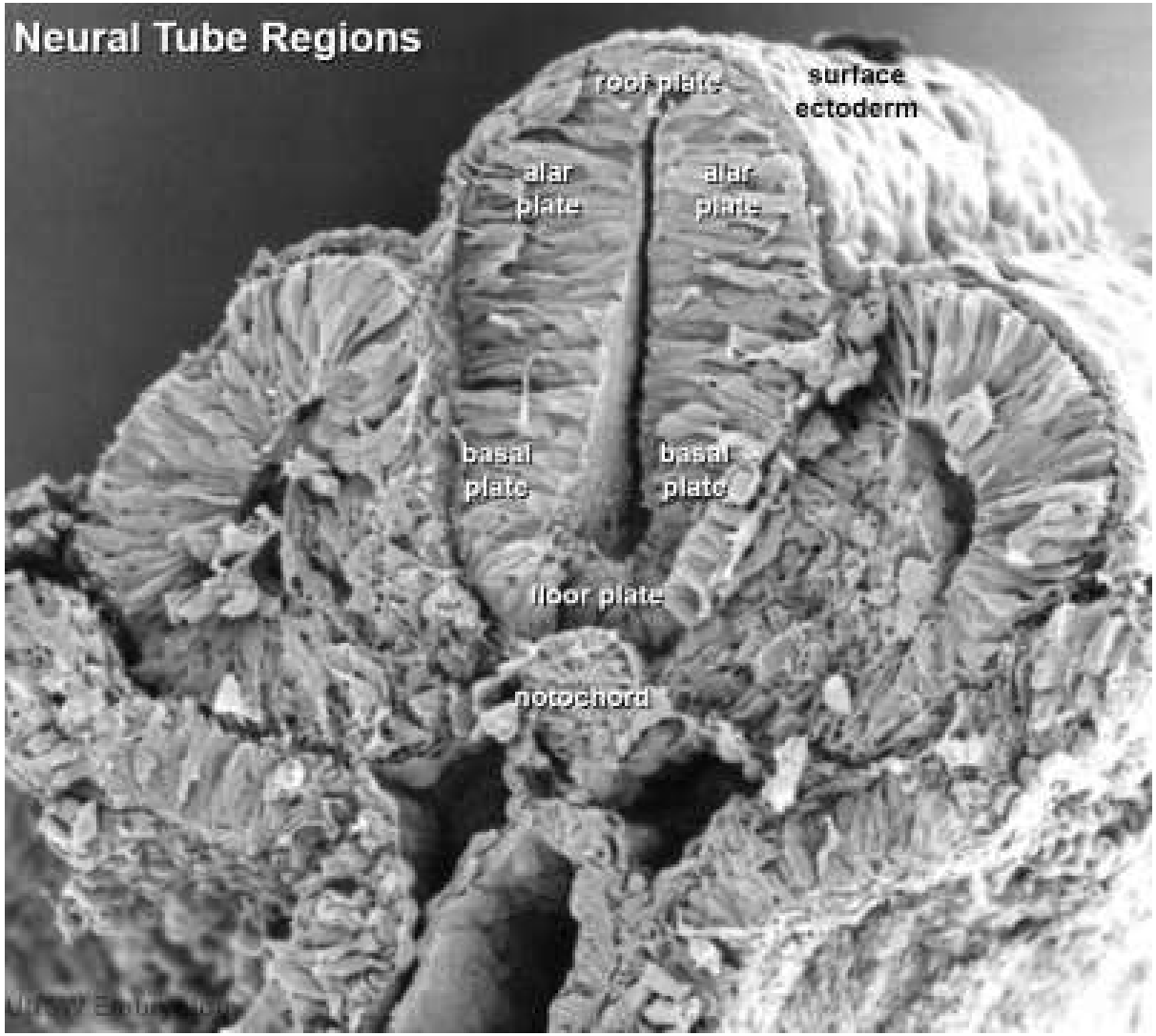


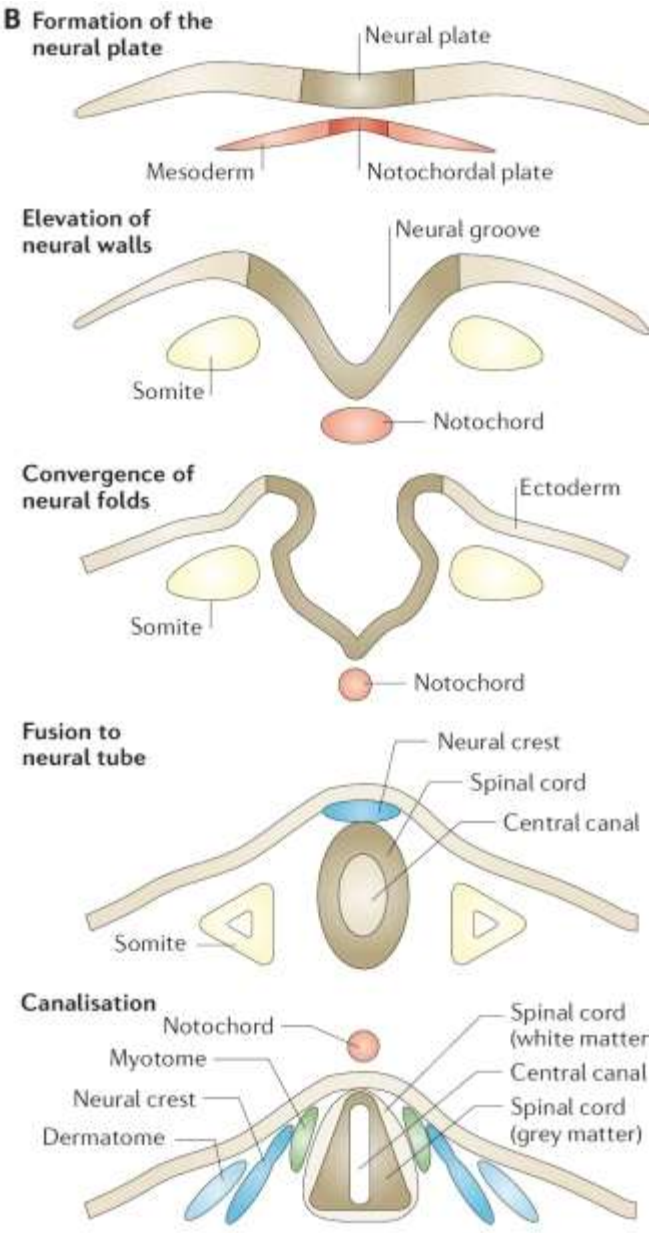


Edtoderm and mesoderm produce BMP4, that induces development of epidermis

Notochord produces inhibitors of BMP4 - noggin, chordin and follistatin (cranially) a wnt3a and FGF (caudally) - ectoderm differentiates into neuroectoderm.

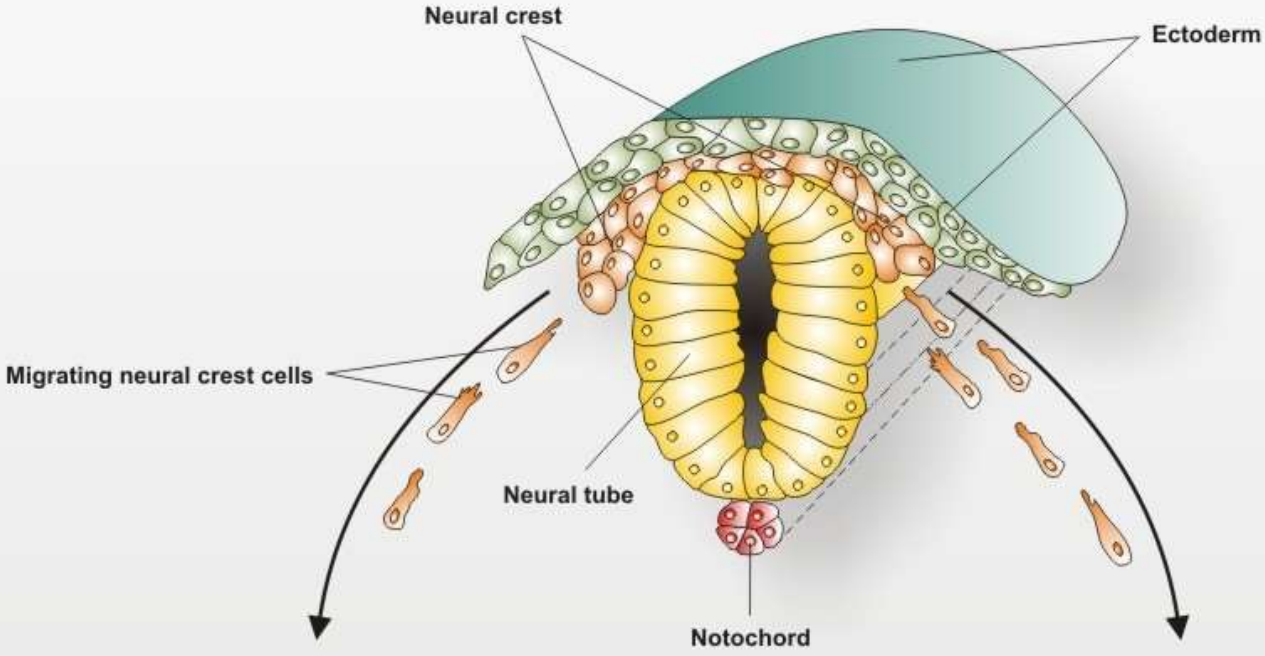
3rd – 4th week

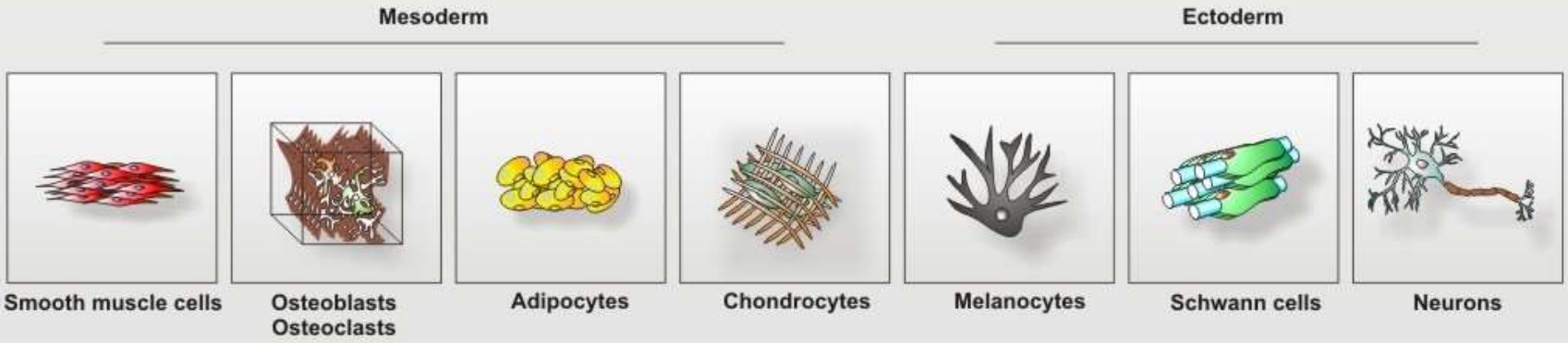

Neural Tube Regions
roof plate
surface ectoderm
alar plate
alar plate
basal plate
basal plate
floor plate
notochord


B Formation of the neural plate
Neural plate
Mesoderm
Notochordal plate
Elevation of neural walls
Neural groove
Somite
Notochord
Convergence of neural folds
Ectoderm
Somite
Notochord
Fusion to neural tube
Neural crest
Spinal cord
Central canal
Somite
Canalisation
Notochord
Myotome
Neural crest
Dermatome
Spinal cord (white matter
Central canal
Spinal cord (grey matter)

NEURULATION

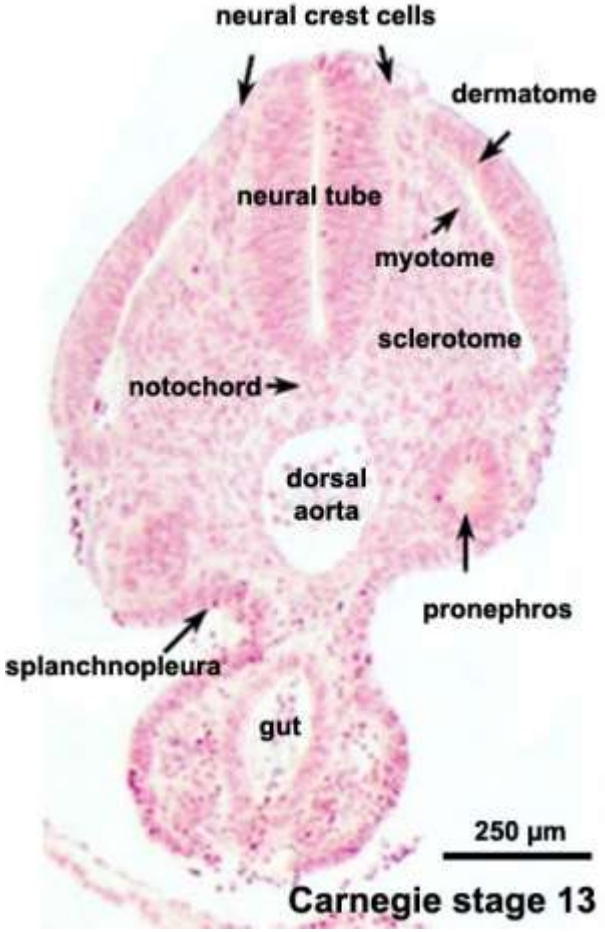
NEURAL TUBE AND NEURAL CREST

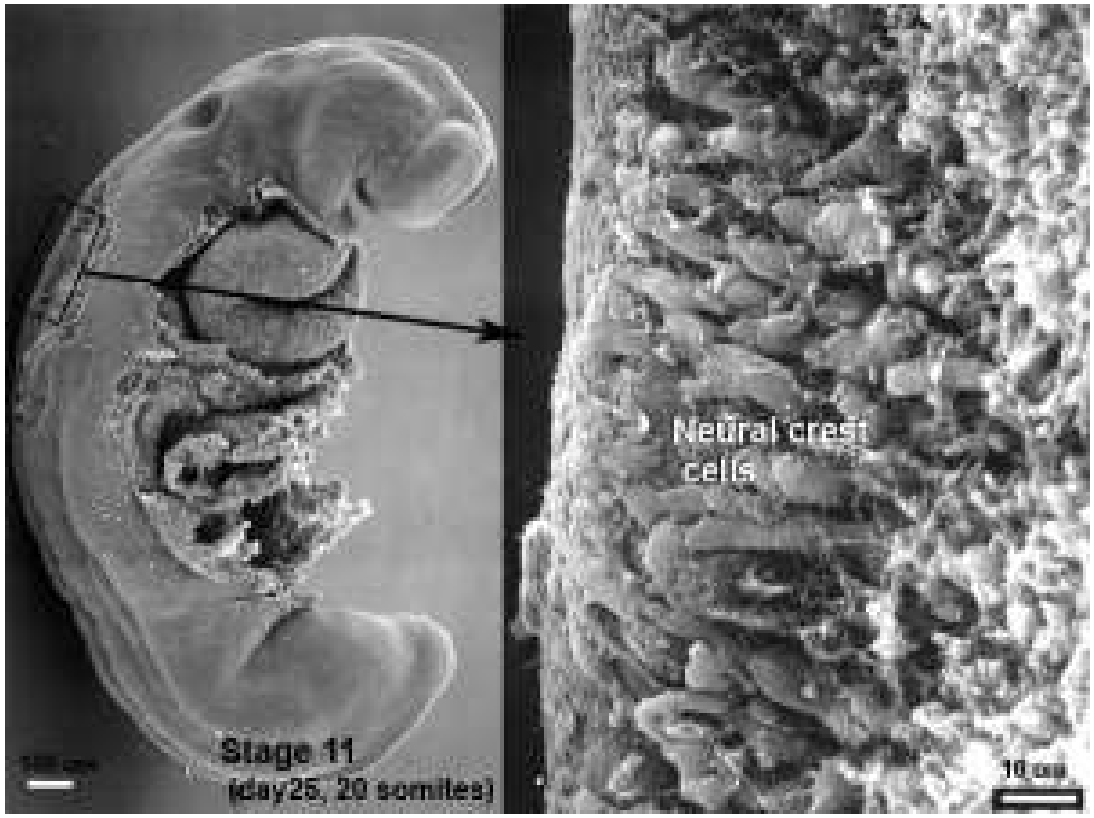




NEURULATION

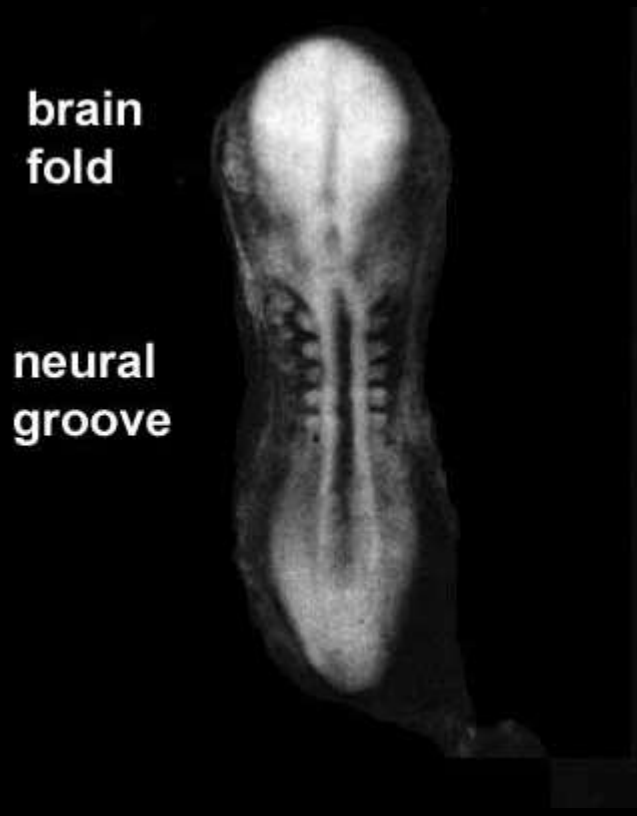
NEURAL TUBE AND NEURAL CREST

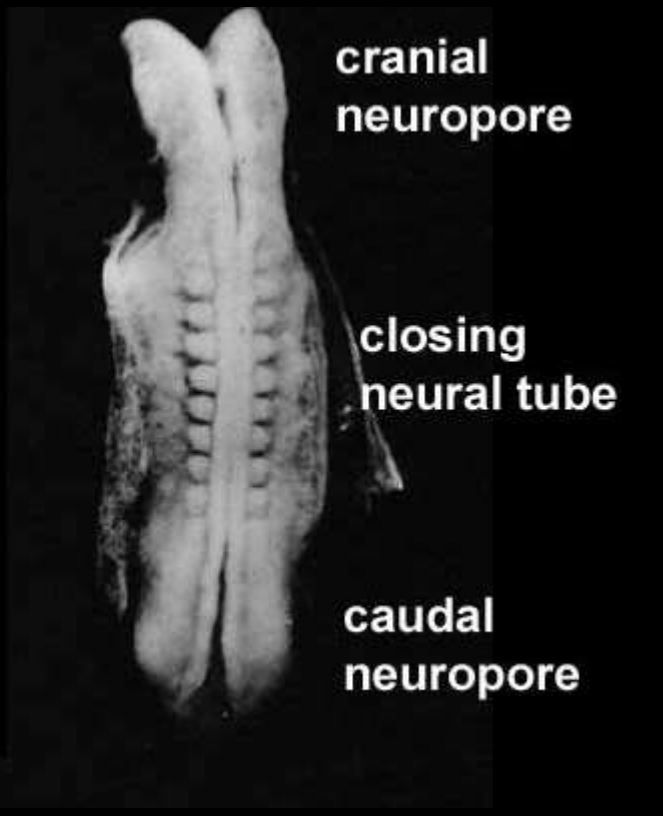




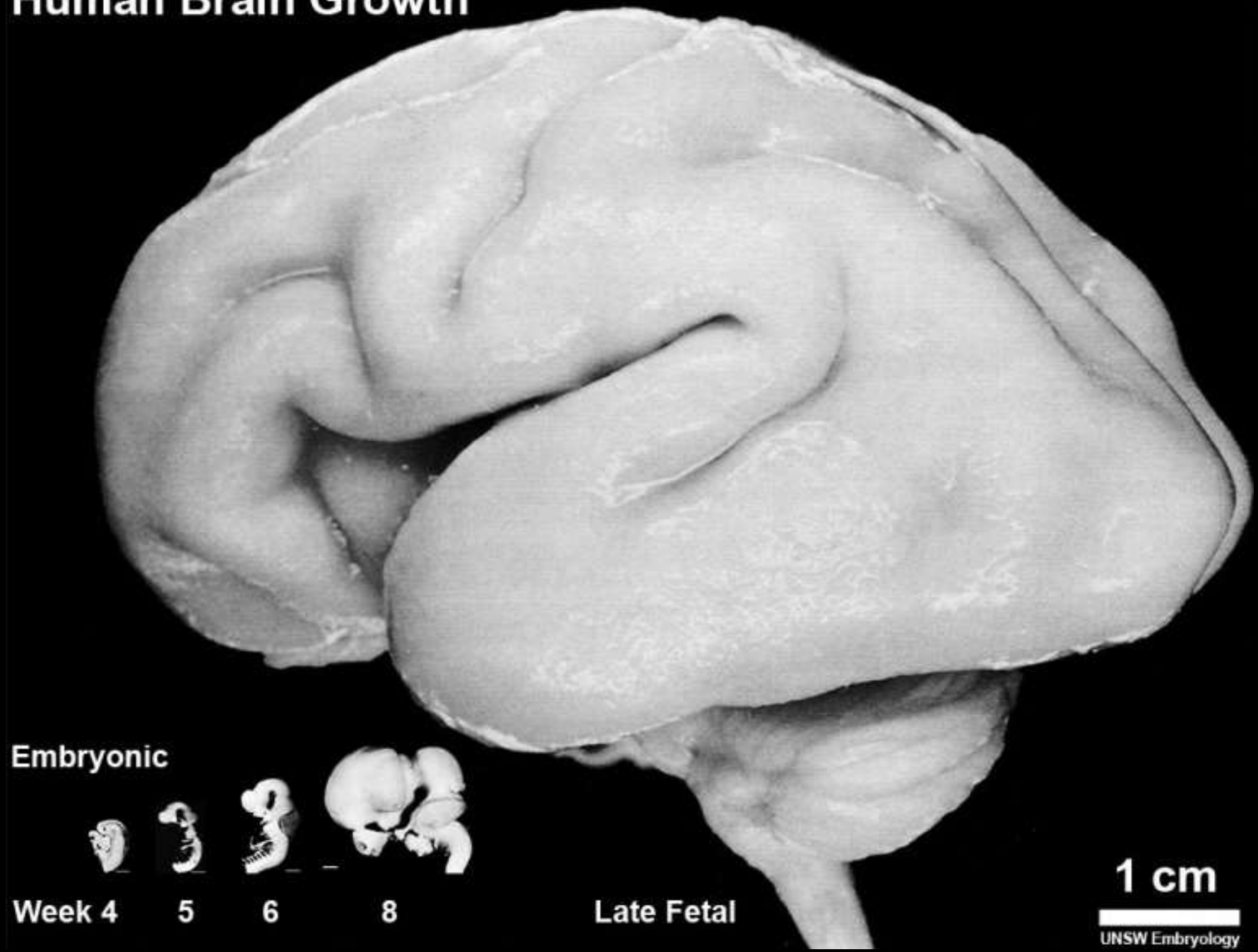
NEURAL TUBE


UNSW Embryology


brain fold
neural groove

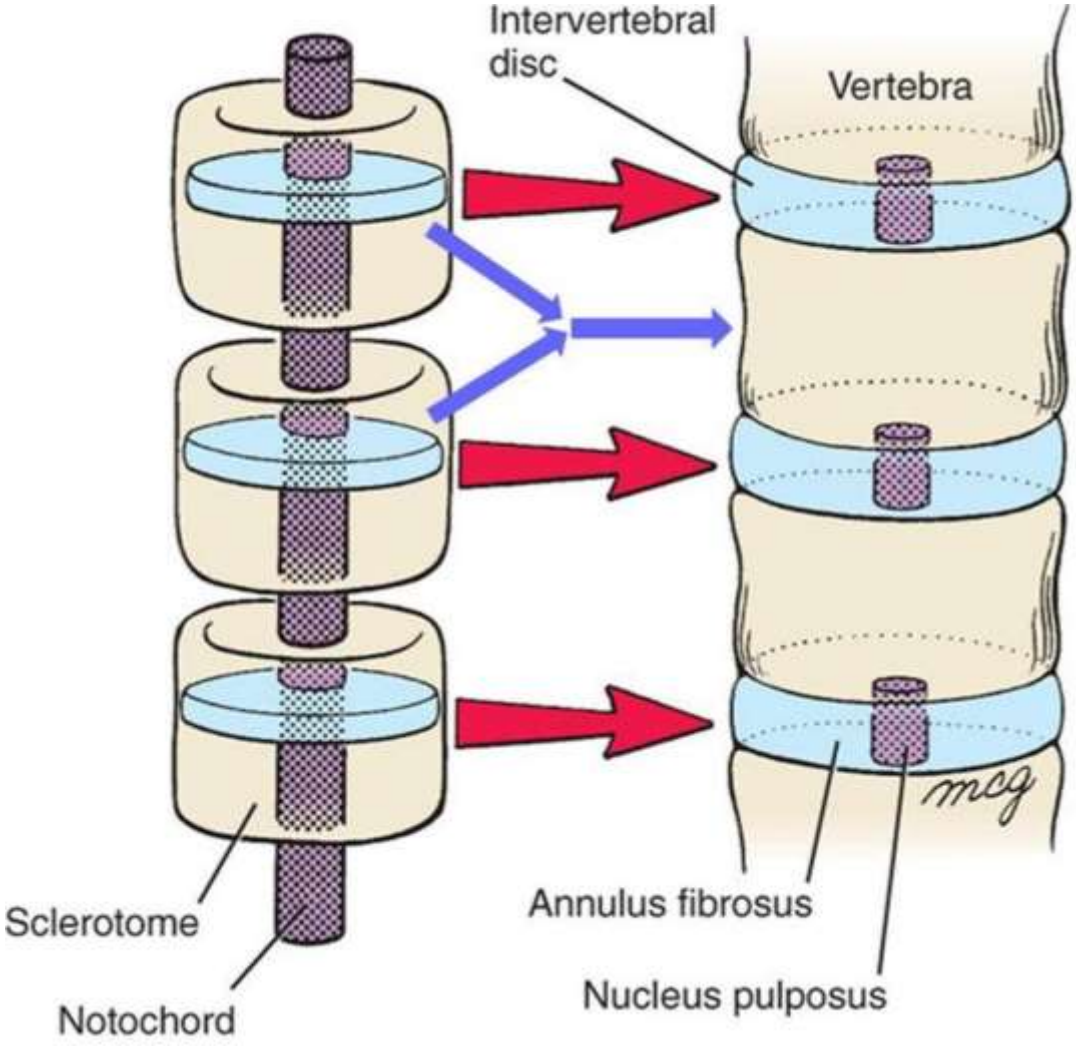

cranial neuropore
closing neural tube
caudal neuropore

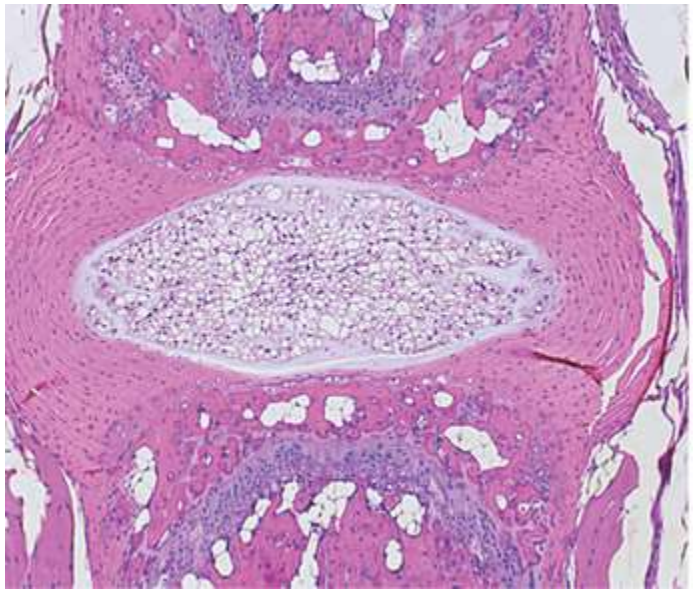
Human Brain Growth



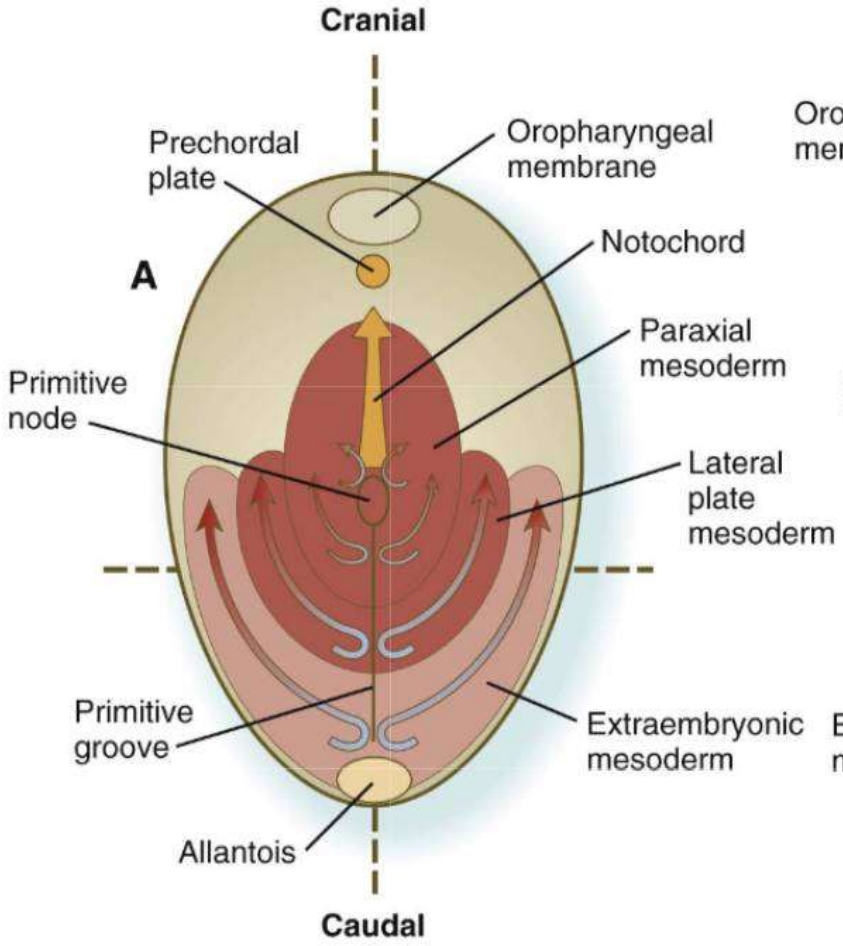
NOTOCHORD IN ADULT BODY

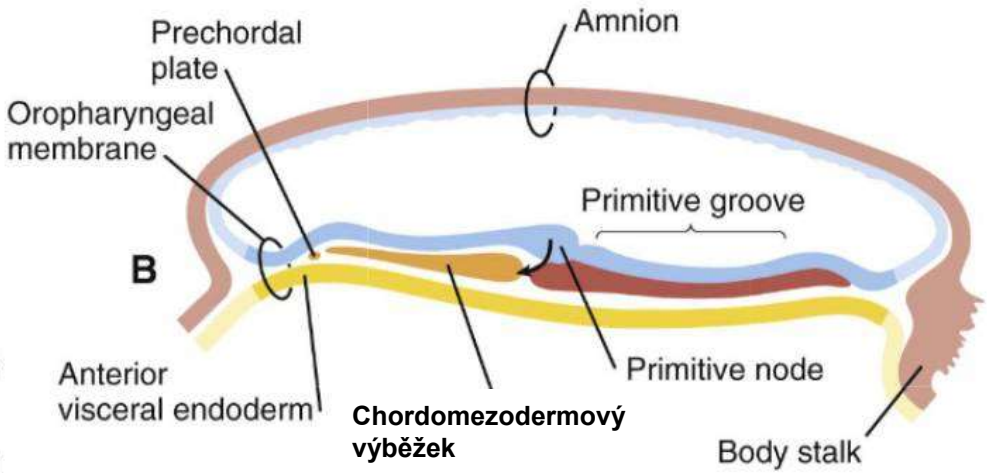
INTERVERTEBRAL DISC

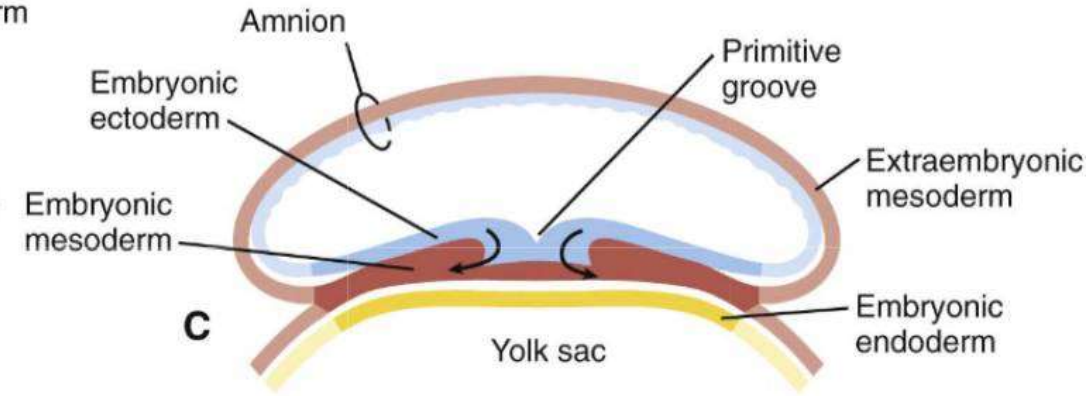




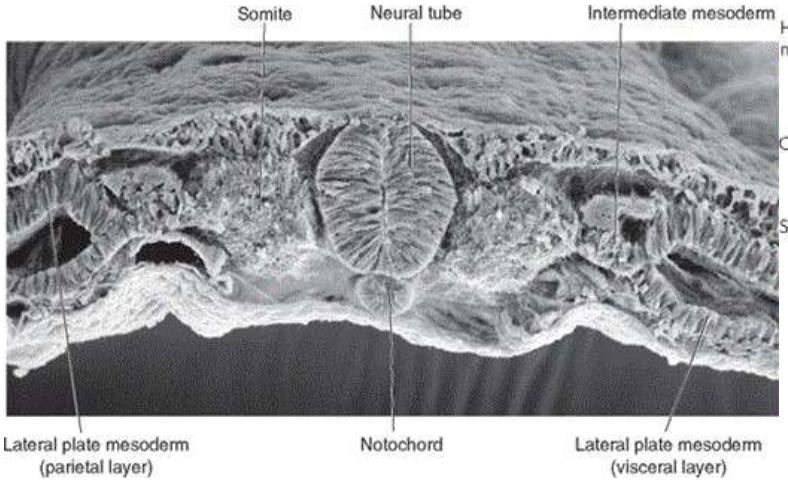
3rd week

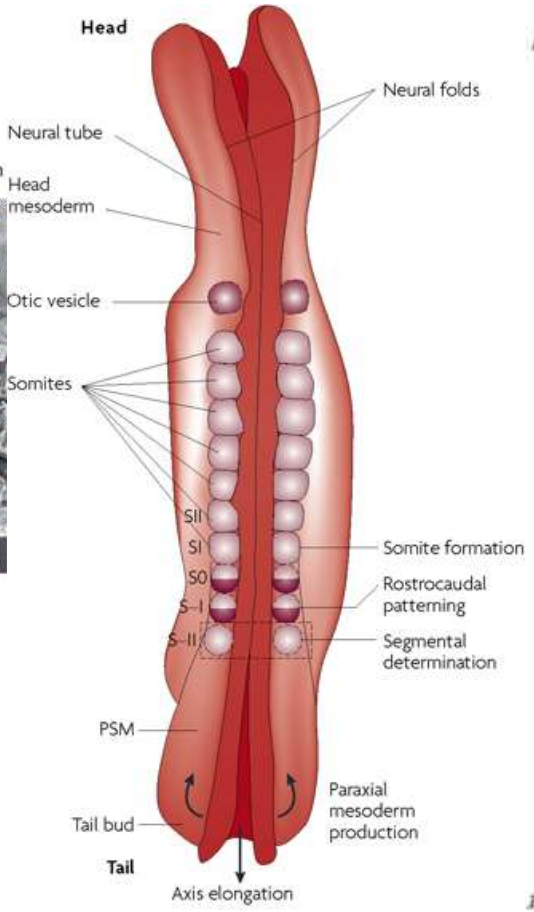

Cranial
Prechordal plate
Oropharyngeal membrane
Notochord
A
Paraxial mesoderm
Primitive node
Lateral plate mesoderm
Primitive groove
Extraembryonic mesoderm
Allantois
Caudal

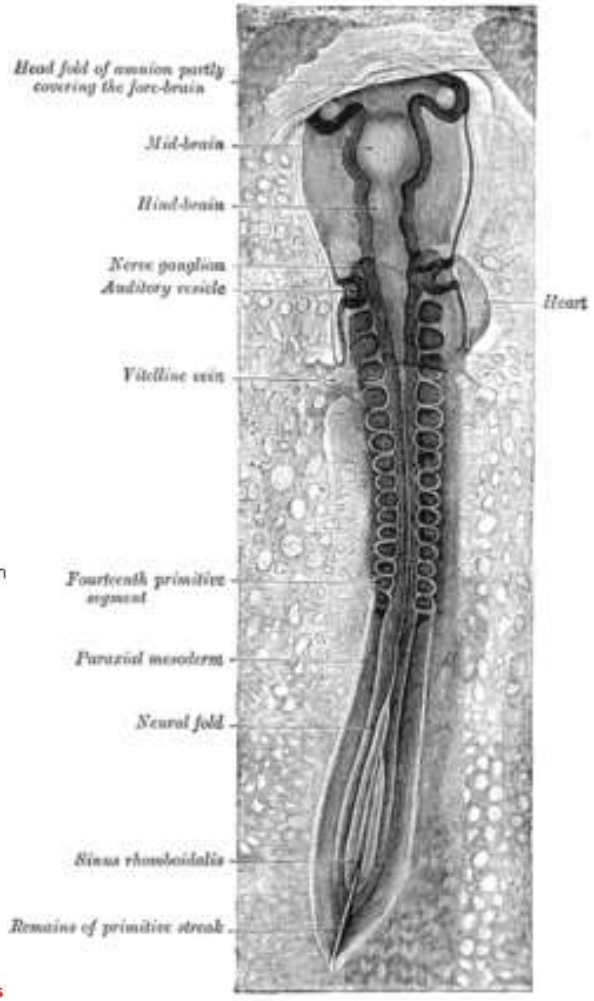

Prechordal plate
Amnion
Oropharyngeal membrane
Primitive groove
B
Anterior visceral endoderm
Primitive node
Chordomezodermový výběžek
Body stalk


Amnion
Primitive groove
Embryonic ectoderm
Extraembryonic mesoderm
Embryonic mesoderm
C
Embryonic endoderm
Yolk sac

3rd – 4th week

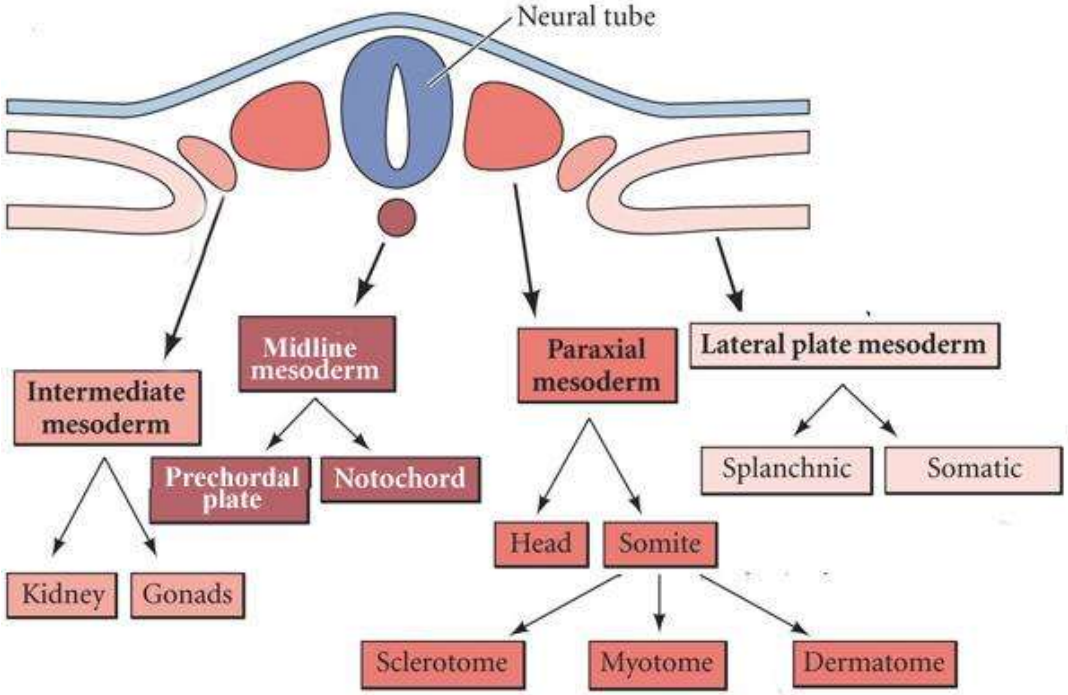

Somite
Neural tube
Intermediate mesoderm
Lateral plate mesoderm (parietal layer)
Notochord
Lateral plate mesoderm (visceral layer)

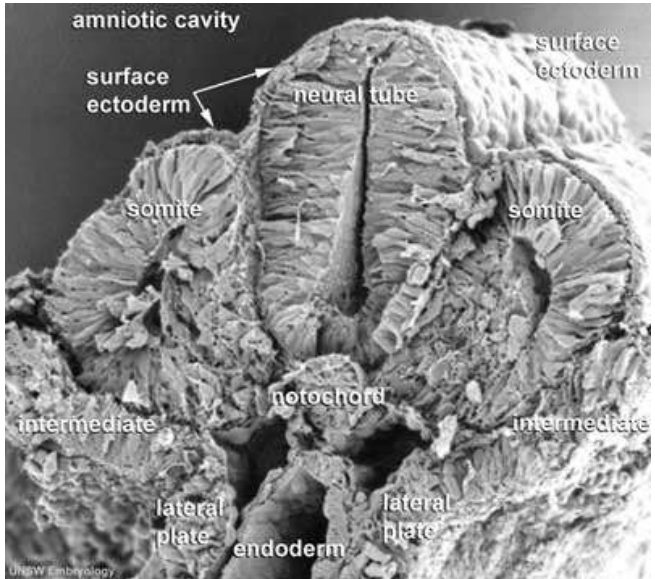

Head
Neural folds
Neural tube
Head mesoderm
Otic vesicle
Somites
SII
SI
S0
S-I
S-II
Somite formation
Rostrocaudal patterning
Segmental determination
PSM
Tail bud
Tail
Paraxial mesoderm production
Axis elongation
Nature Reviews | Genetics

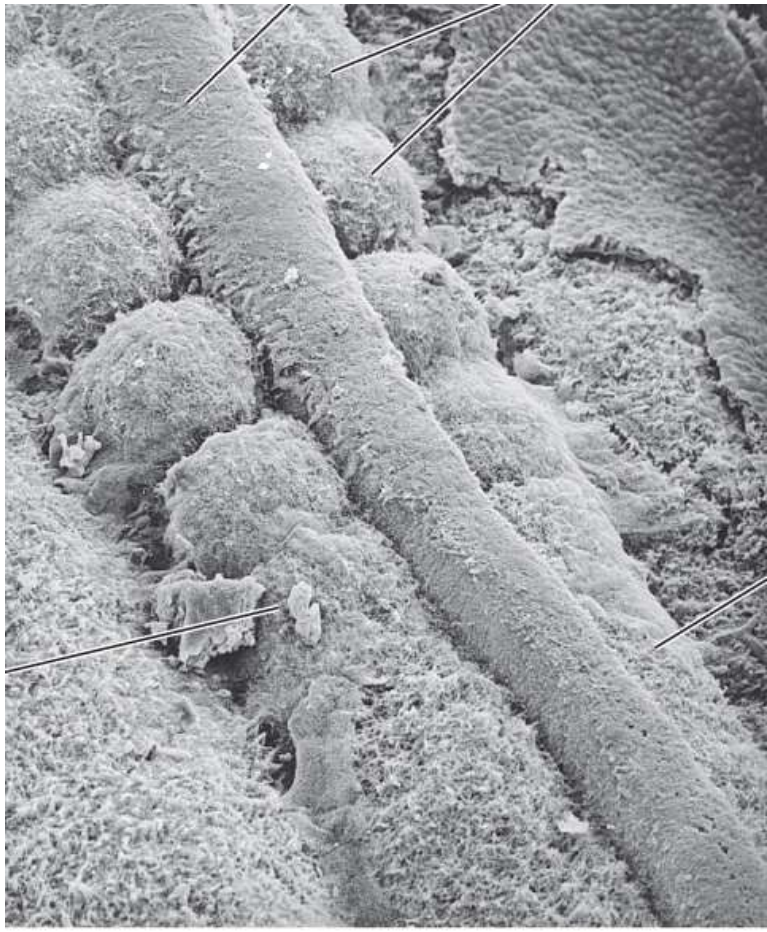

Head fold of amnion partly covering the fore-brain
Mid-brain
Hind-brain
Nerve ganglion
Auditory vesicle
Heart
Vitelline vein
Fourteenth primitive segment
Paraxial mesoderm
Neural fold
Sinus rhomboidalis
Remains of primitive streak

DERIVATIVES OF MESODERM

SOMITES

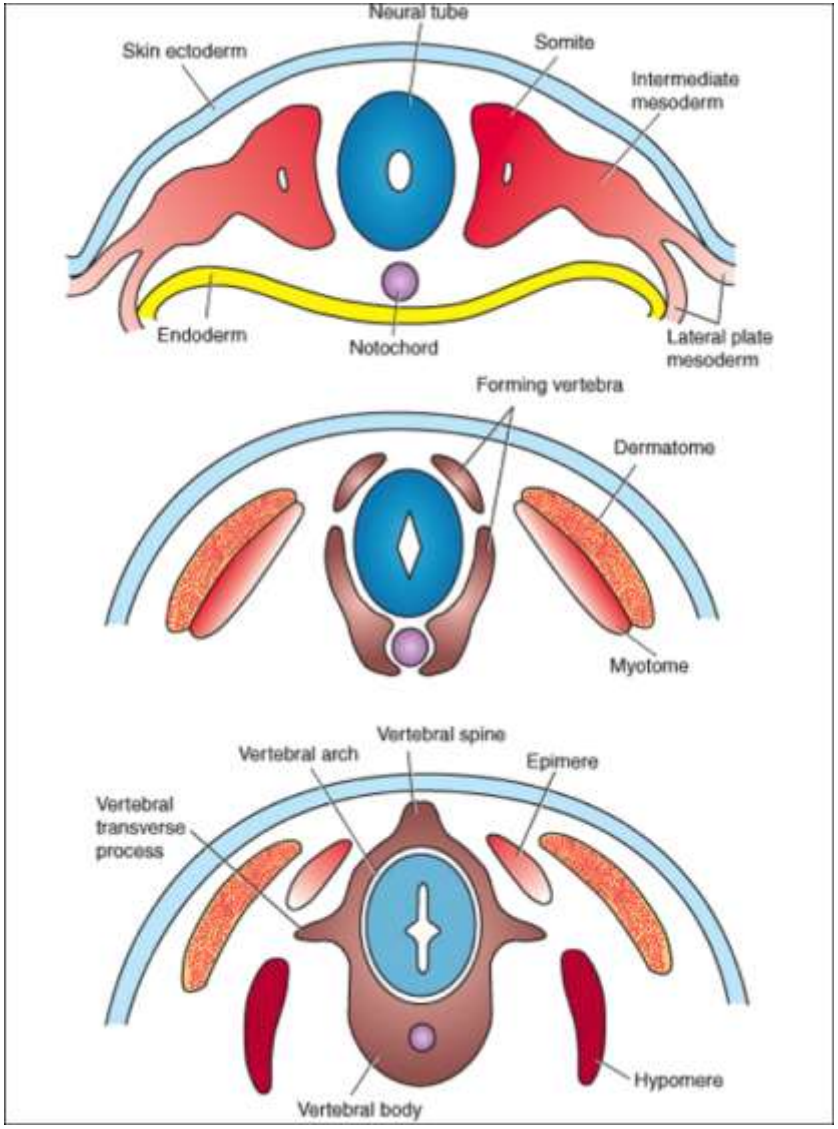


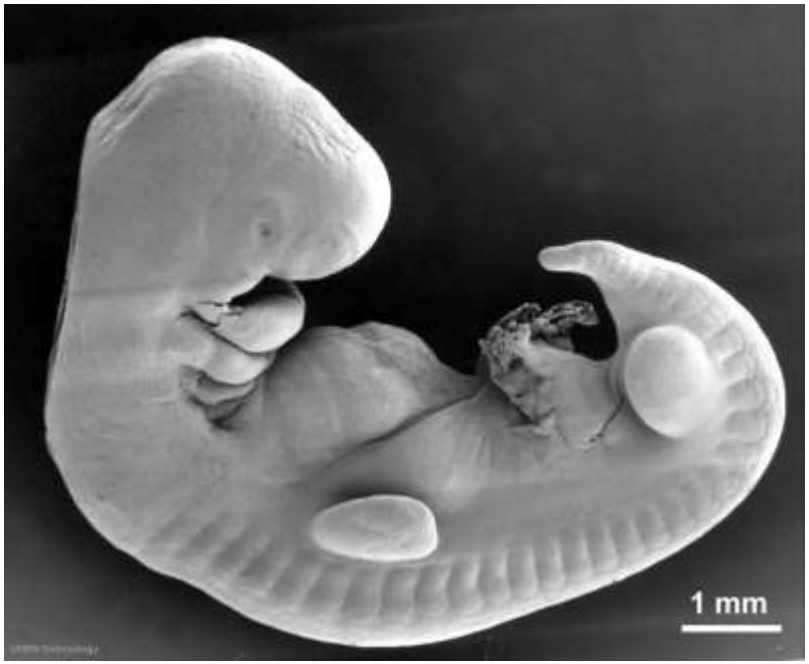




DERIVATIVES OF MESODERM

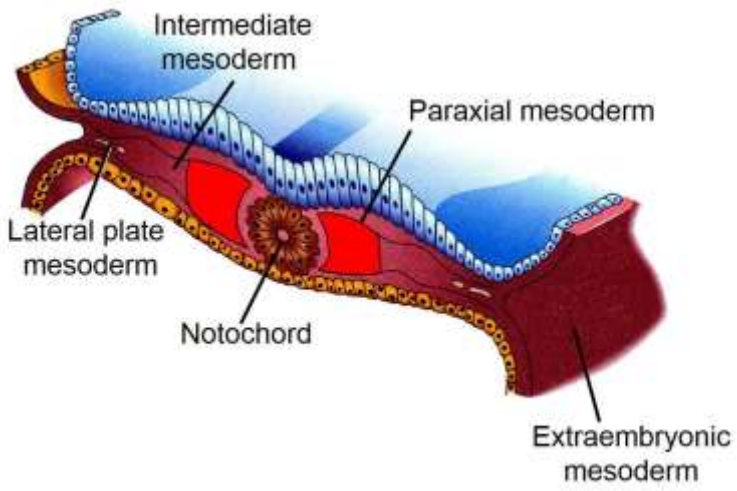
SOMITES

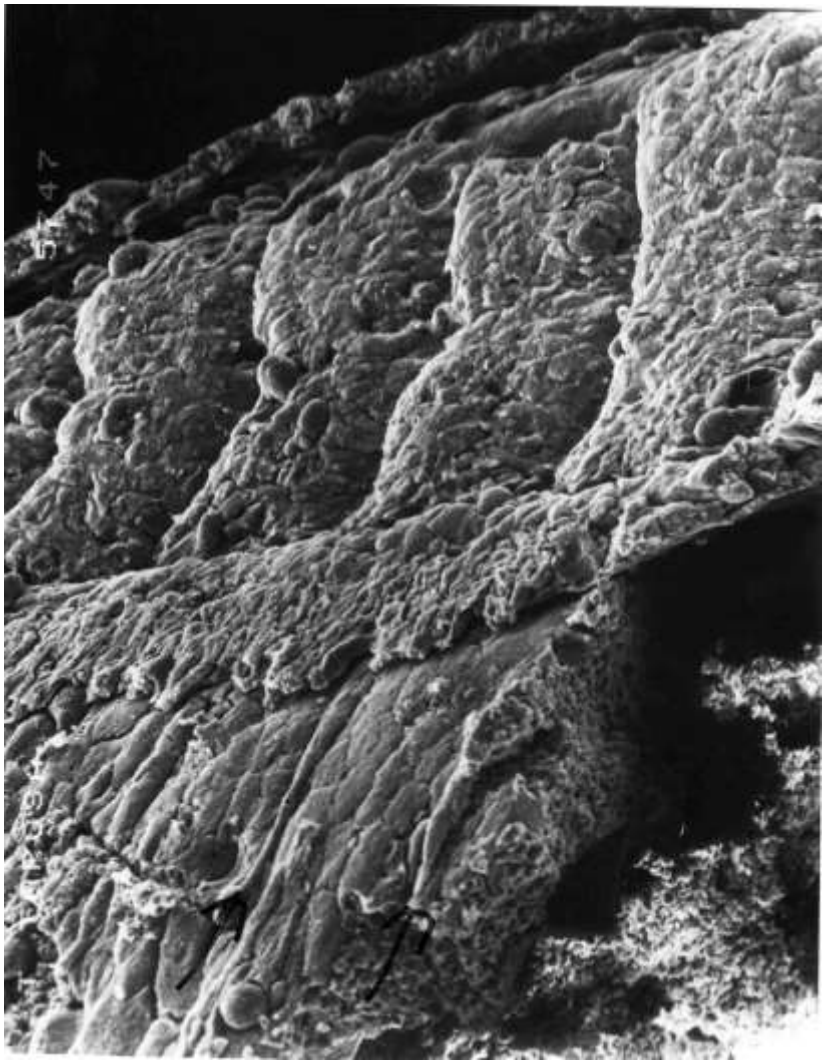




OTHER DERIVATIVES OF MESODERM

3rd – 4th week





- heart, cardiovascular system
- urogenital system
- muscle and skeletal system
- hematopoietic and lymphatic systems
- connective tissue, dermis
- mesothelium

DEVELOPMENTAL DISORDERS DURING GASTRULATION

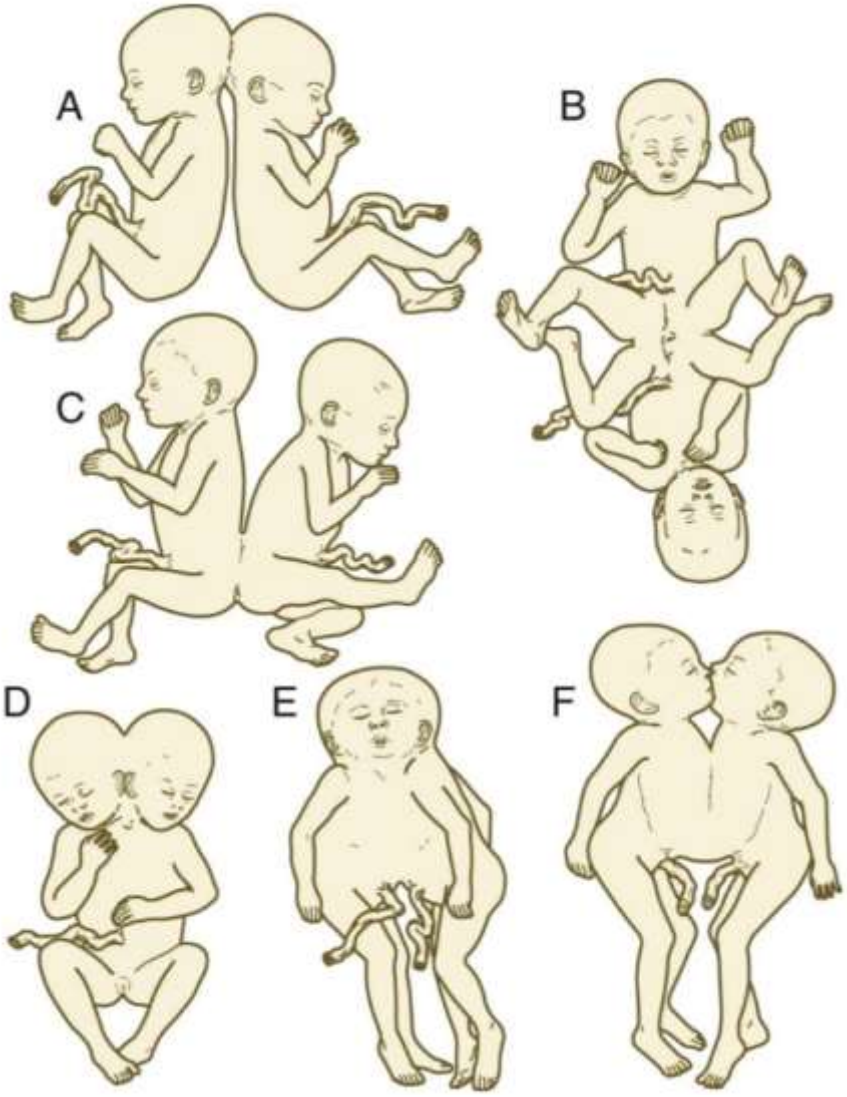
- Primitive streak is a temporary embryonic structure. Persistent primitive streak causes **sacrococcgyeal teratoma**.

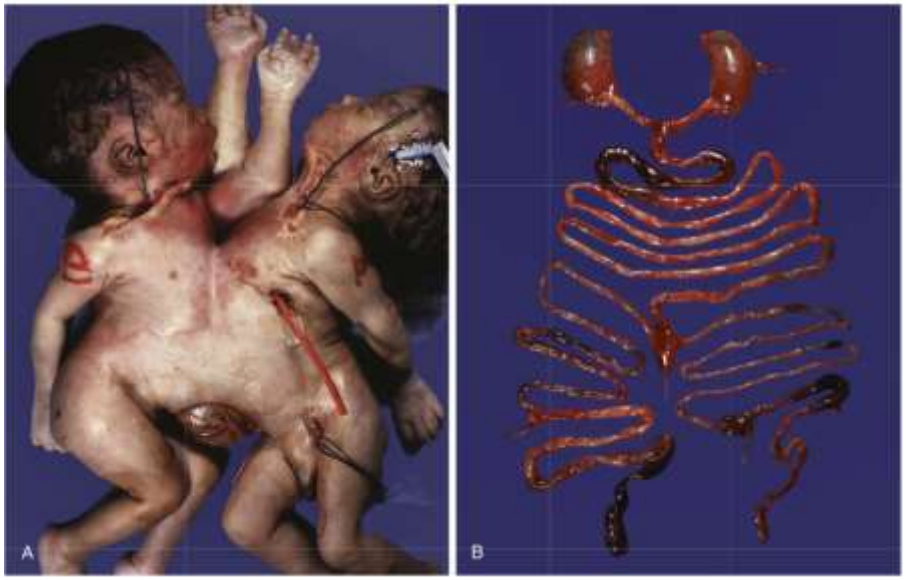
- Failure of primitive streak leads to absence of mesoderm in affected region - **sirenomelia**

- limbs
- urogenital system
- GIT

DEVELOPMENTAL DISORDERS DURING GASTRULATION

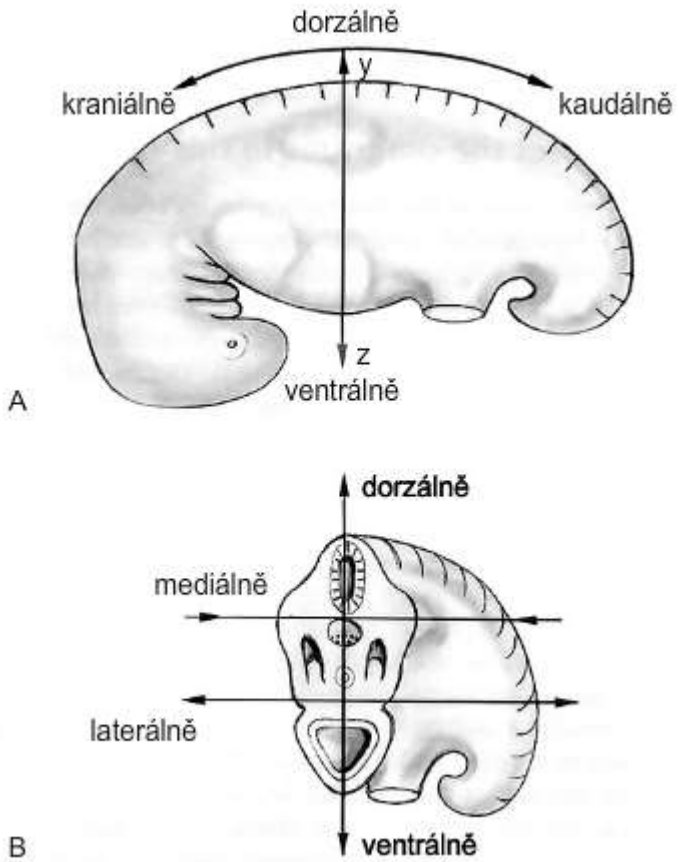
- If two primitive streaks form, conjoined twins may develop

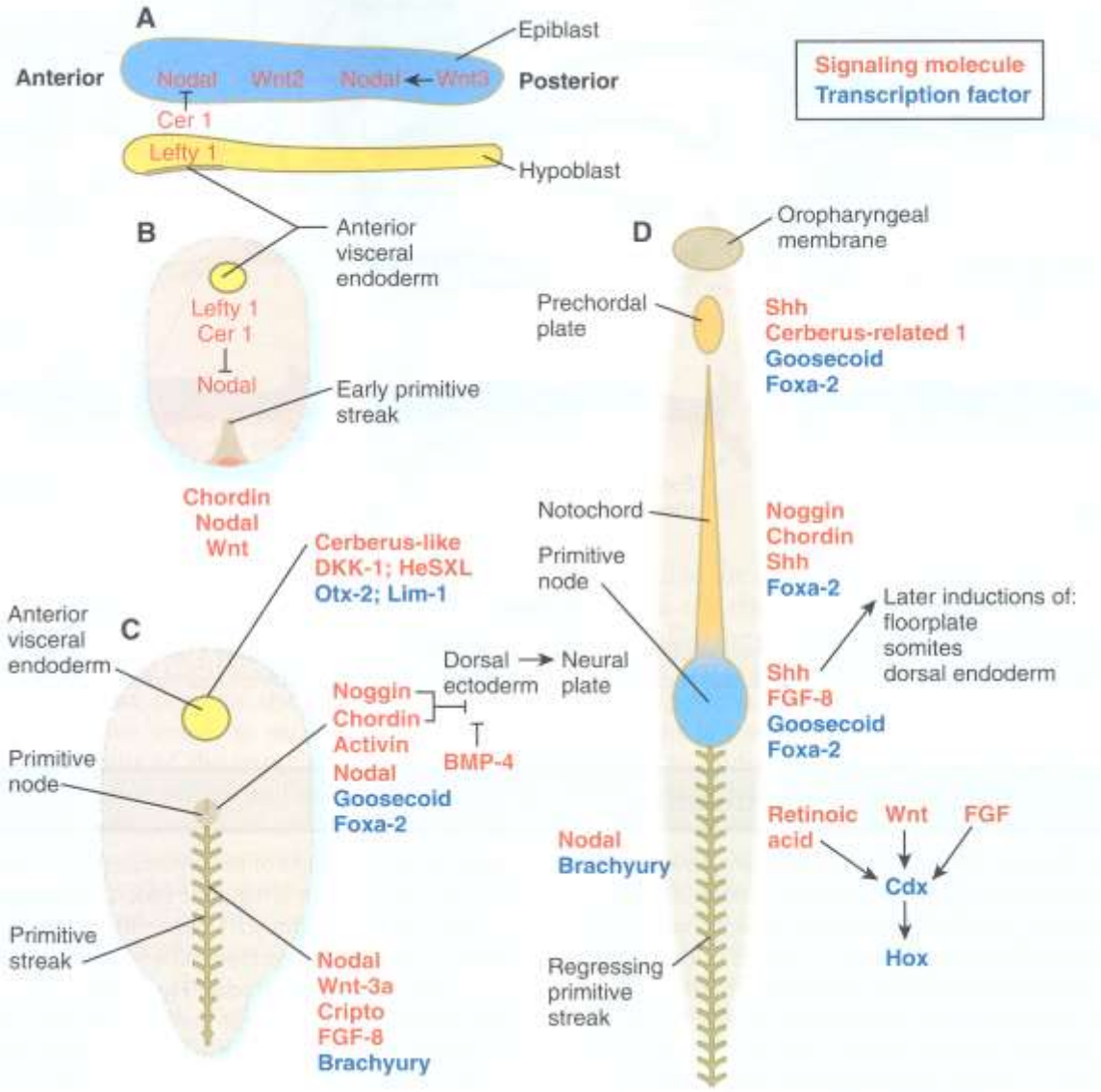




WHAT DETERMINES EMBRYONIC AXES?

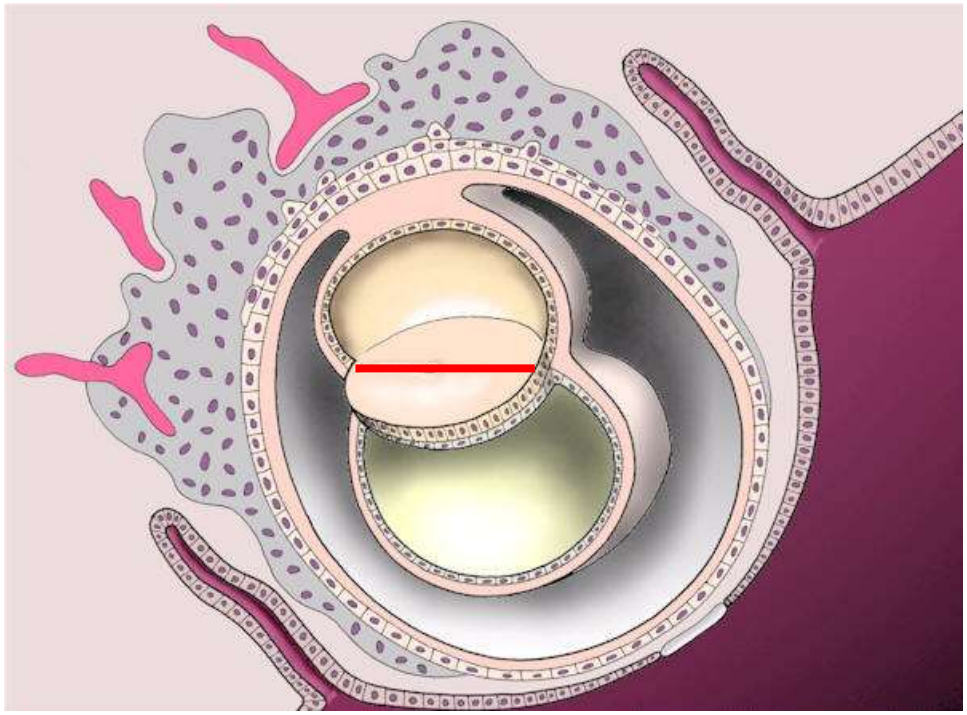
3rd week

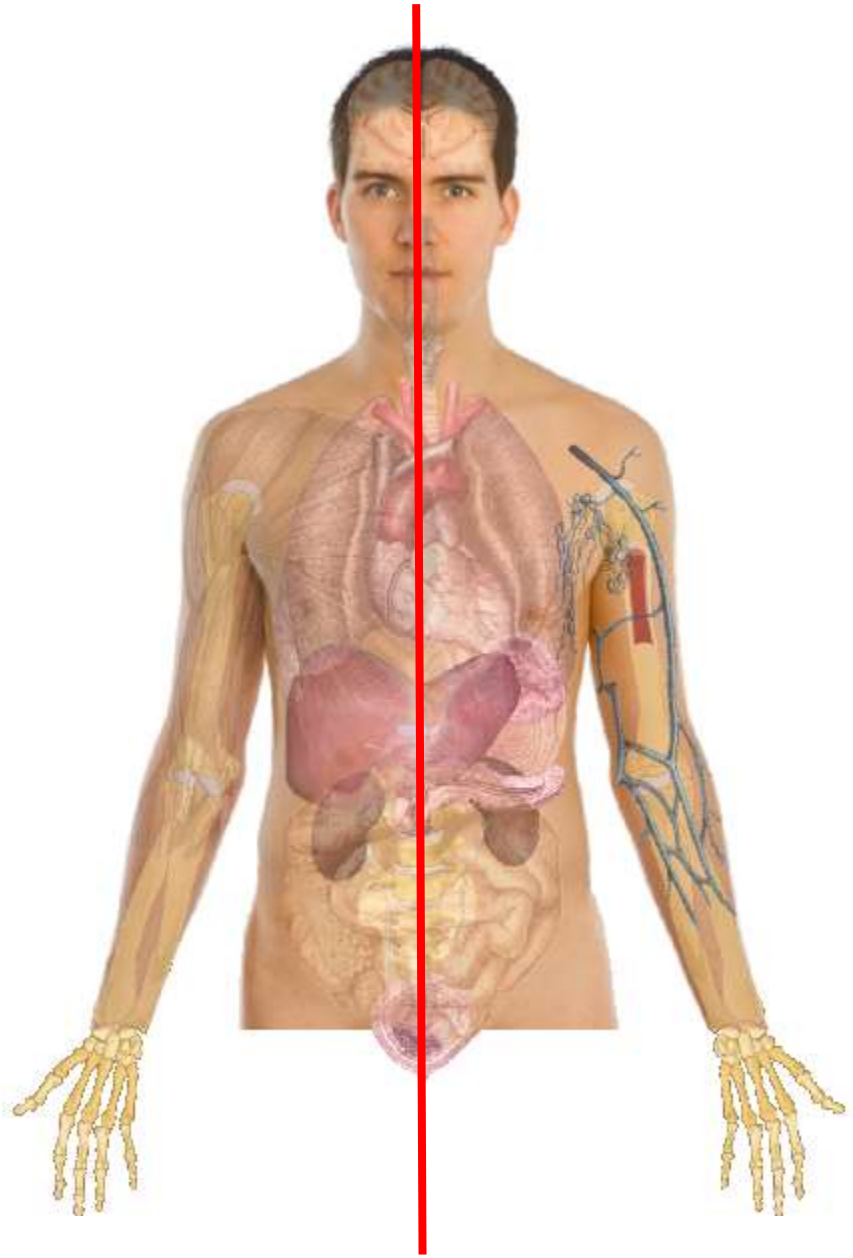




DEVELOPMENT OF LEFT-RIGHT ASSYMETRY

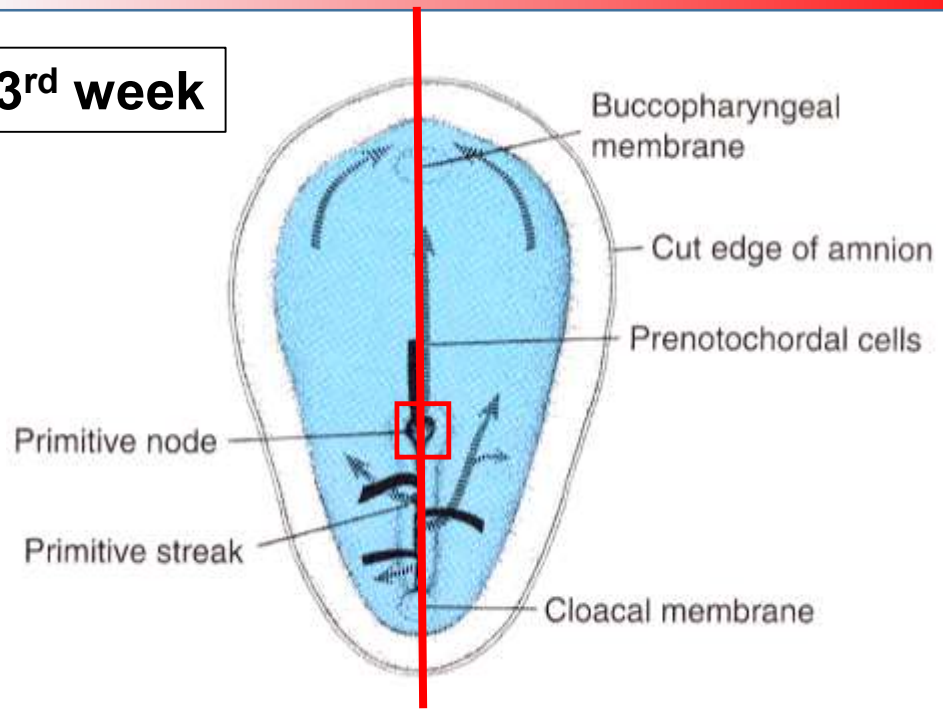
3rd week

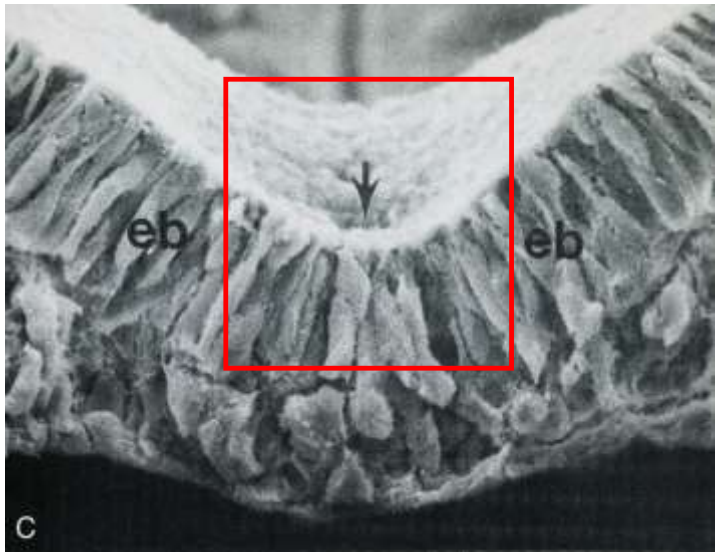


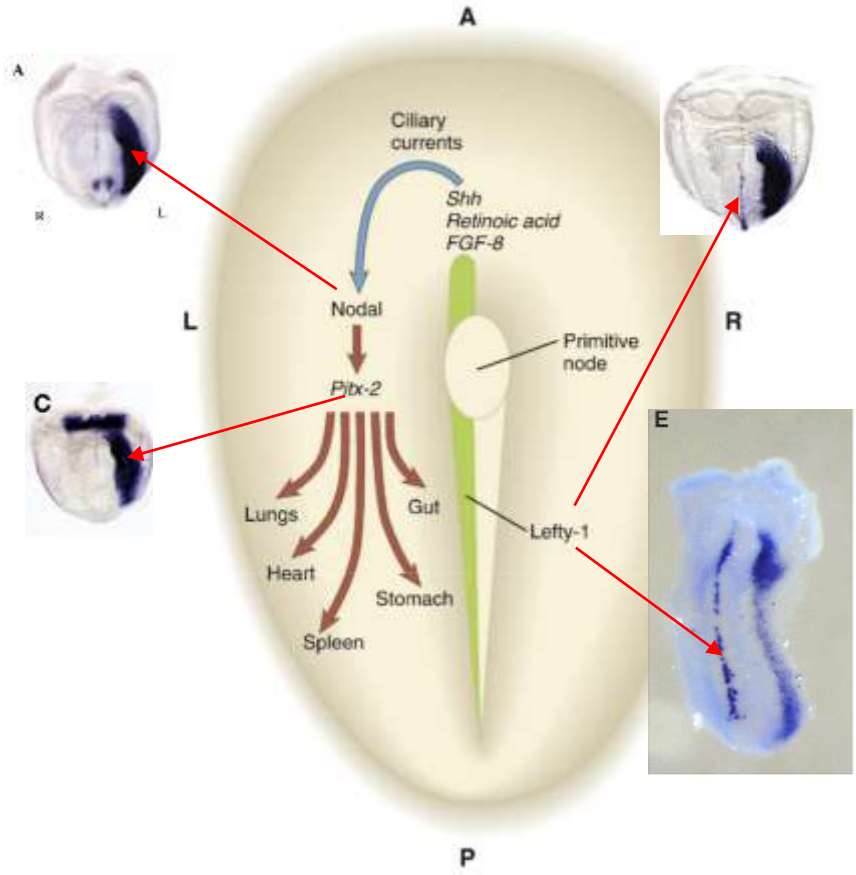


DEVELOPMENT OF LEFT-RIGHT ASSYMETRY

3rd week



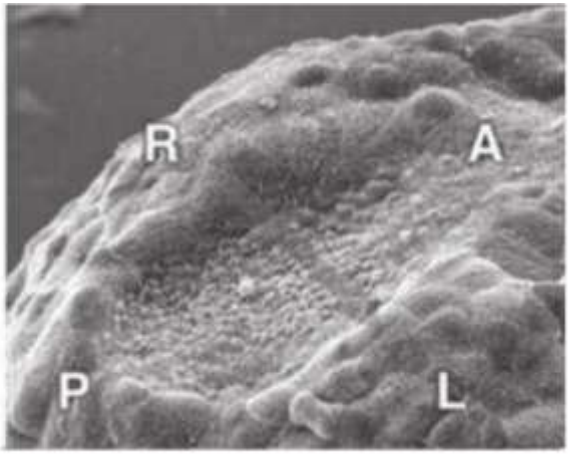


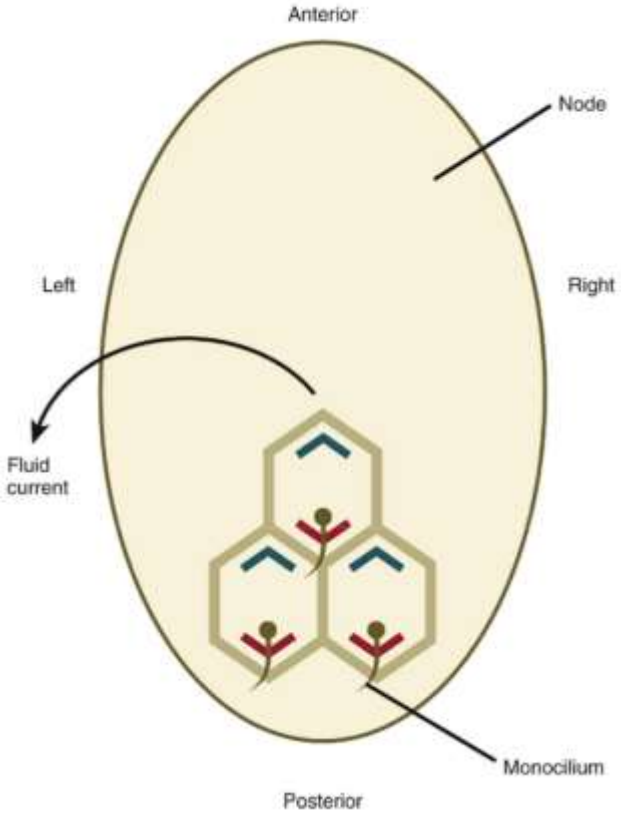


https://doi.org/10.1371/journal.pone.0171180

DEVELOPMENT OF LEFT-RIGHT ASSYMETRY

3rd week



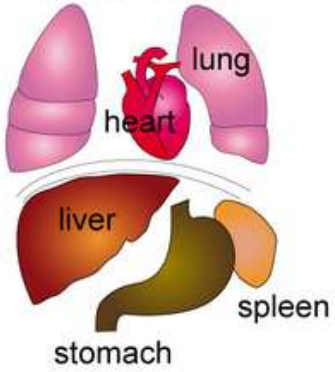


DOI: 10.1111/j.1440-169X.2008.01008.x

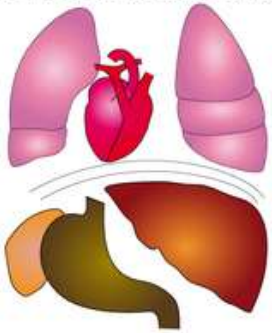
DISORDES IN DEVELOPMENT OF LEFT-RIGHT ASSYMETRY LEAD TO MALFORMATIONS

- situs inversus (1:10 000) × situs solitus
- heterotaxia (situs ambiguus)
- dextrocardia
- isomerism

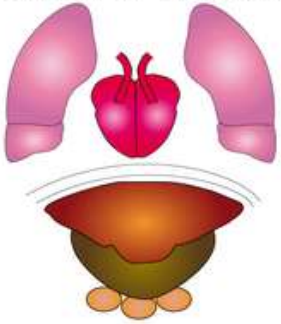
situs solitus

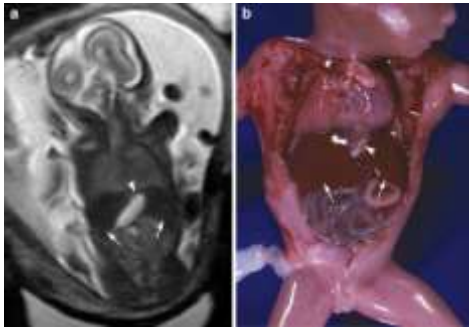


situs inversus totalis

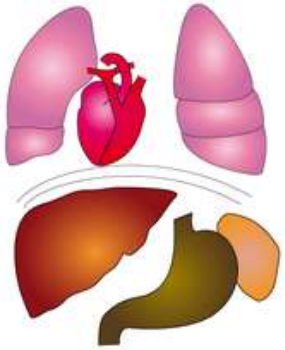


left isomerism (polysplenia)

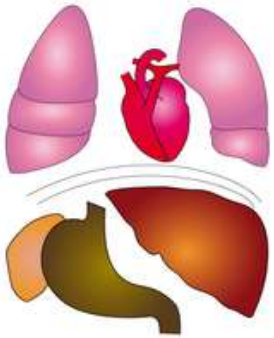




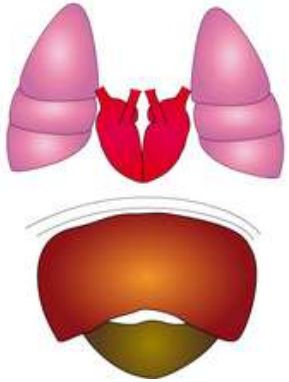
situs inversus thoracalis



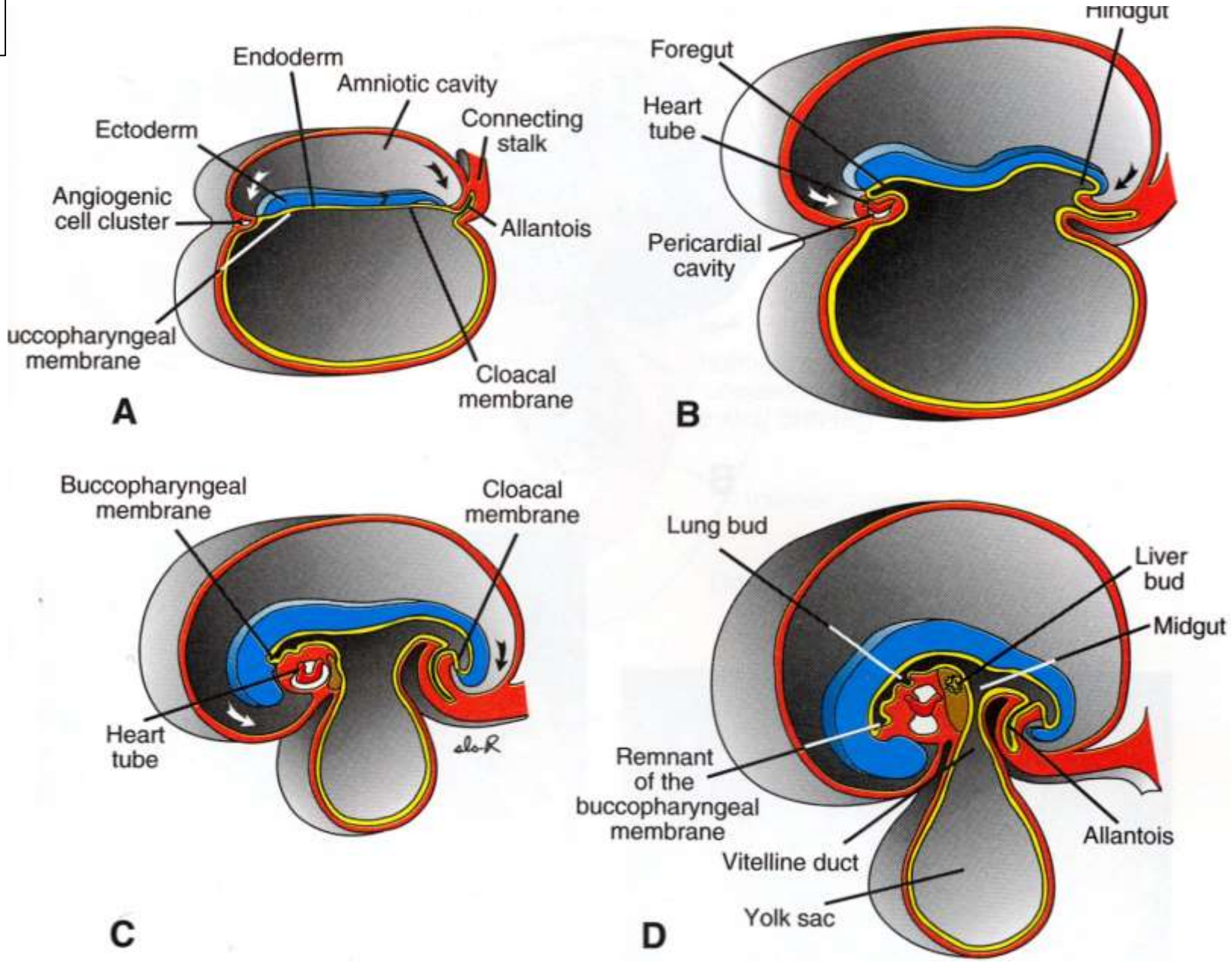
situs inversus abdominalis

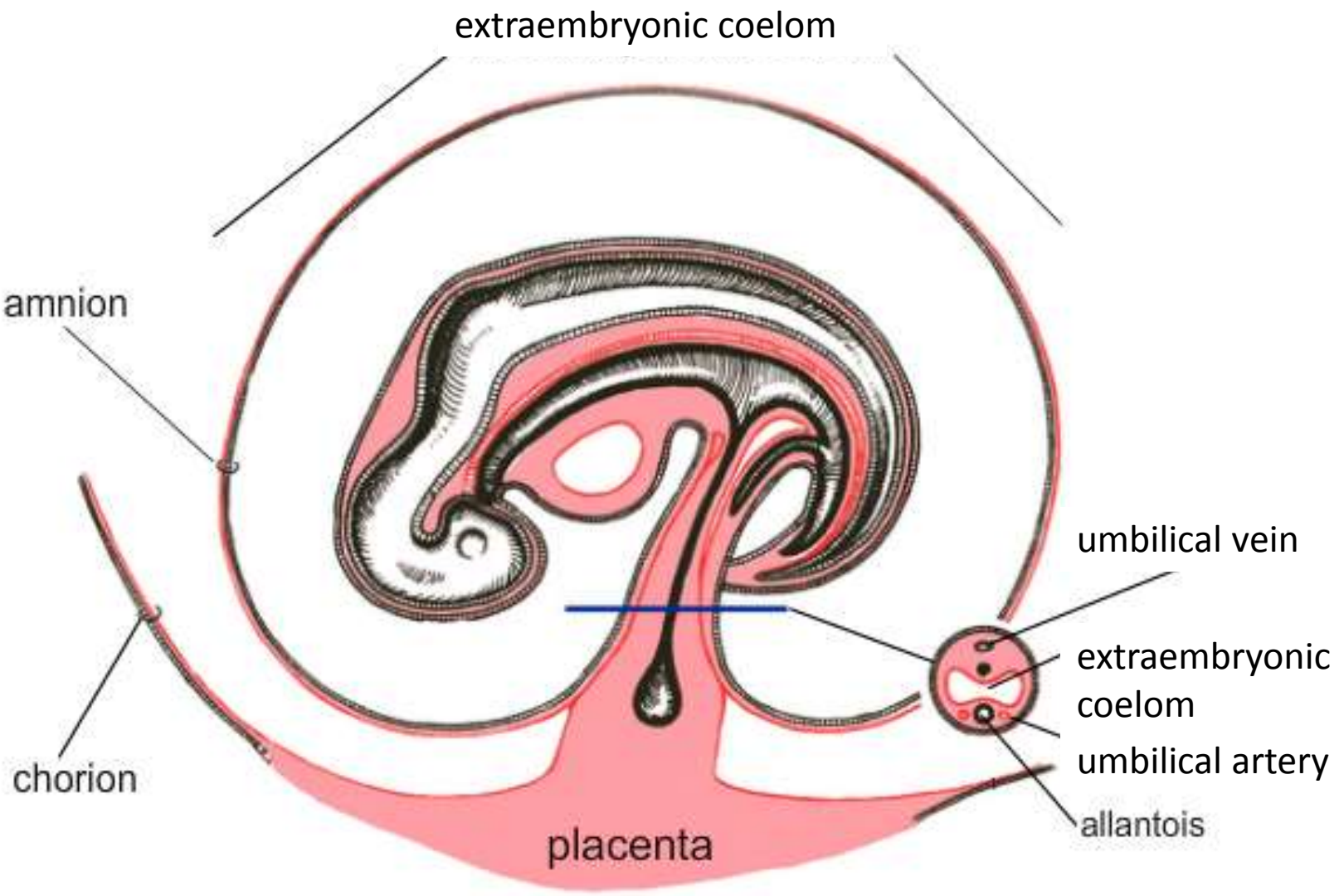


right isomerism (asplenia)

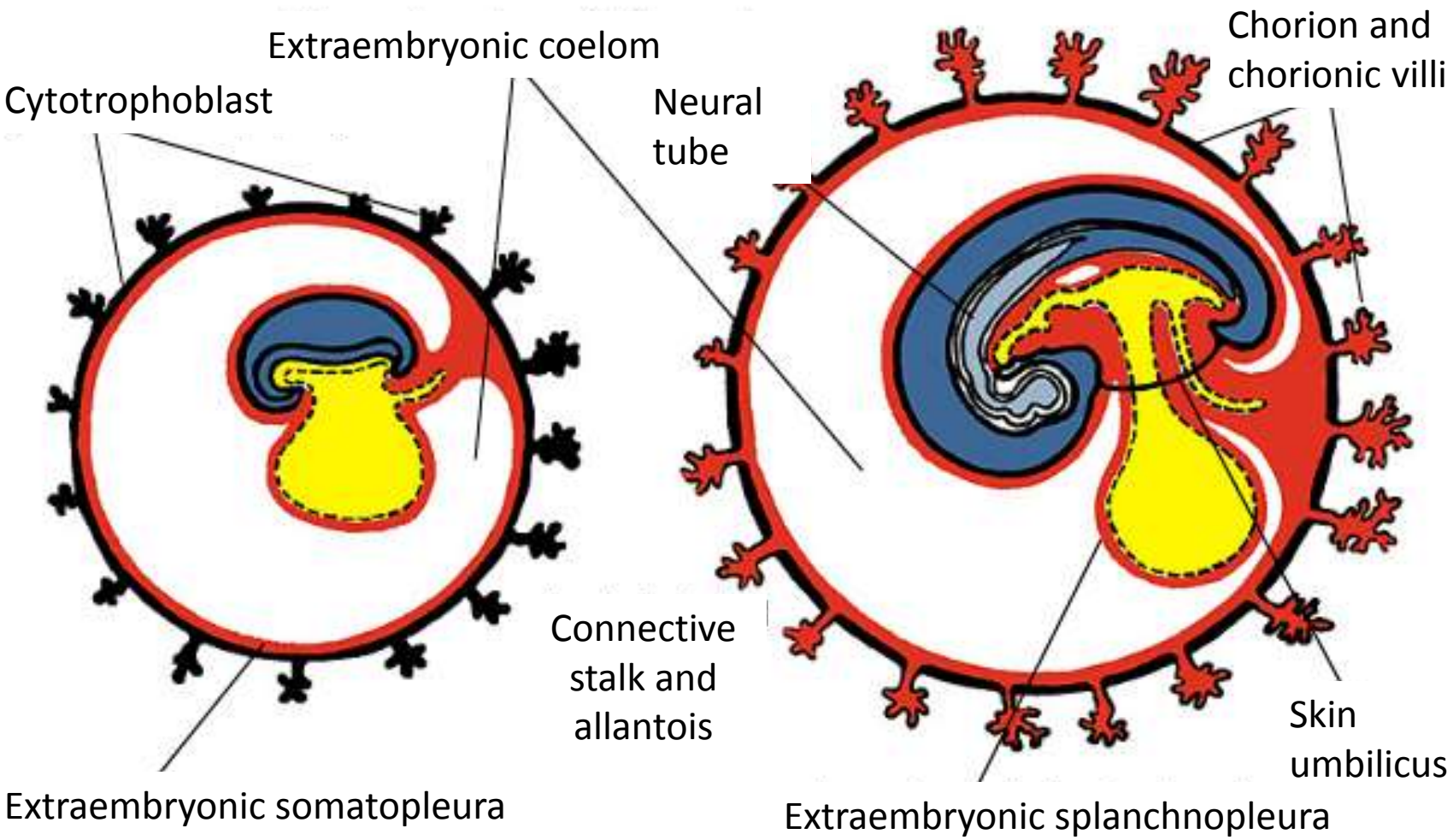


4th week


Endoderm
Amniotic cavity
Ectoderm
Connecting stalk
Angiogenic cell cluster
Allantois
uccopharyngeal membrane
Cloacal membrane
A
Hindgut
Foregut
Heart tube
Pericardial cavity
B
Buccopharyngeal membrane
Cloacal membrane
Heart tube
C
Lung bud
Liver bud
Midgut
Remnant of the buccopharyngeal membrane
Allantois
Vitelline duct
Yolk sac
D


extraembryonic coelom
amnion
umbilical vein
extraembryonic coelom
umbilical artery
allantois
chorion
placenta

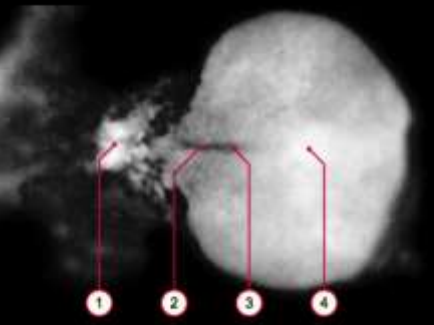
FOLDING OF EMBRYO



- bilaminar → trilaminar germ disc
- cephalocaudal and lateral flexion of embryo

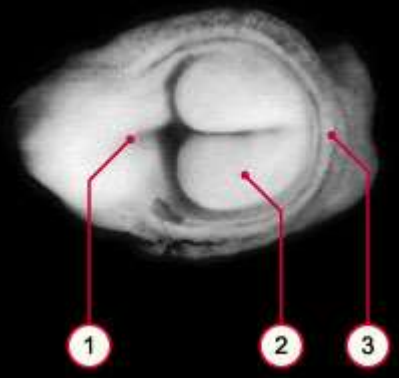
http://www.embryology.ch/anglais/iperiodembry/carnegie03.html#st710

Day 19
0.4 mm
Carnegie stage 7



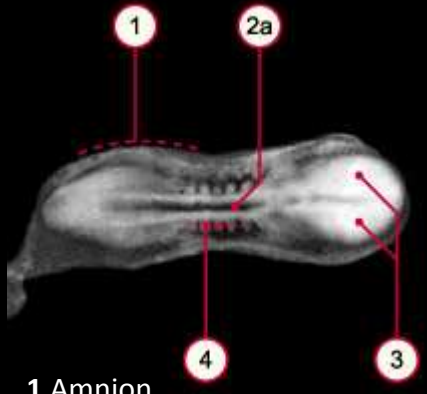
1 Yolk sac
2 Primitive streak
3 Primitive node
4 Germ disc

Day 25
1.5-2.5 mm
Carnegie stage 9



1 Primitive streak
2 Neural folds
3 Amnion

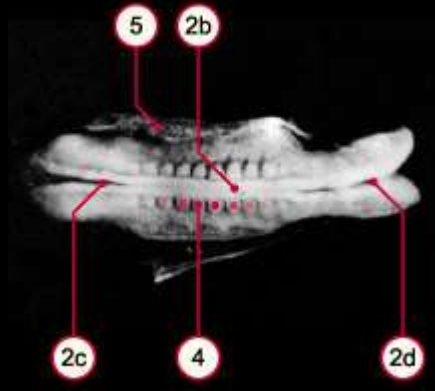
Dorsal



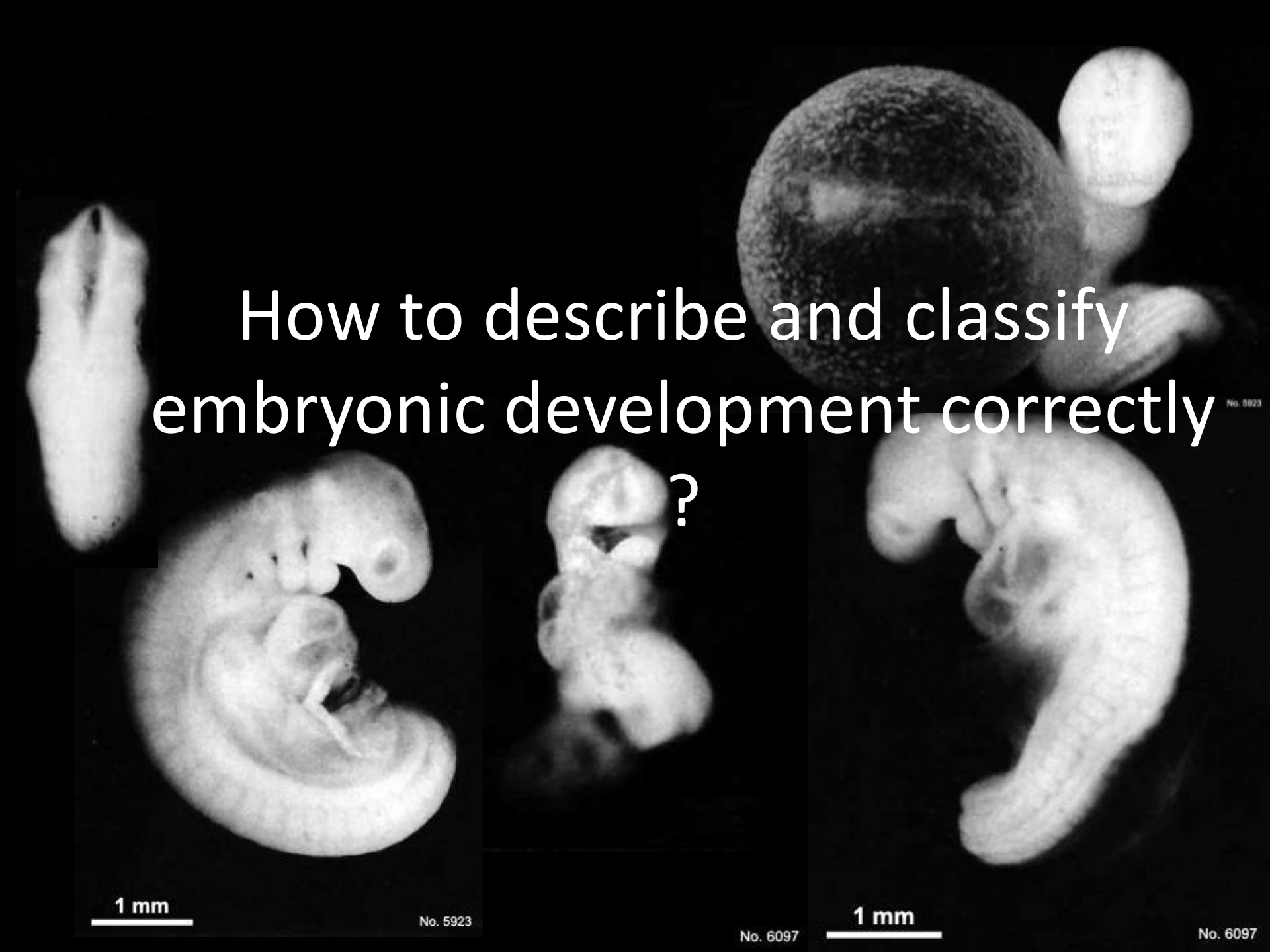
1 Amnion
2a Neural ridge
2b Neural tube
2c Caudal neuroporus
2d Rostral neuroporus

Day 28
2-3.5 mm
Carnegie stage 10

Ventral

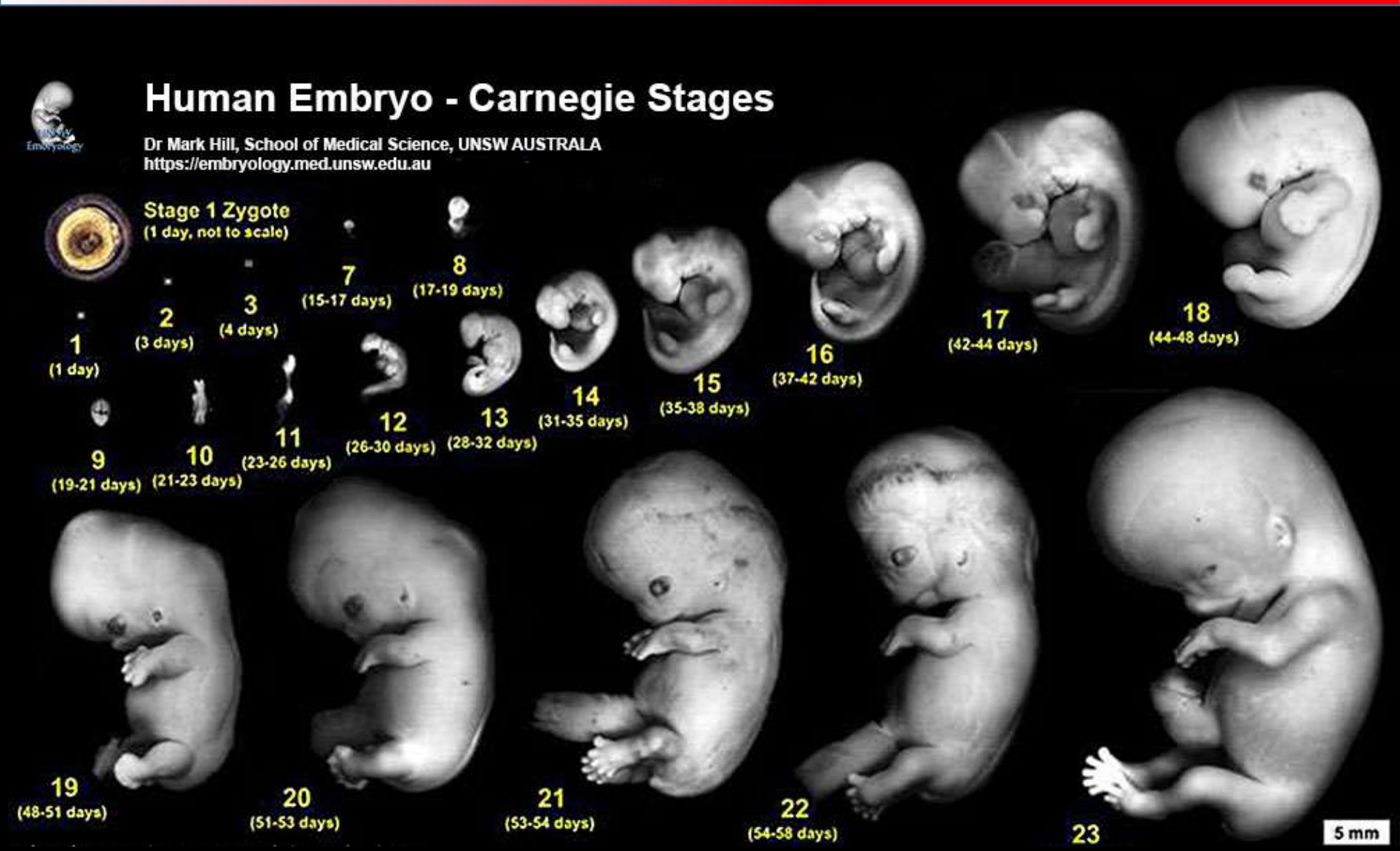


3 Neural folds
4 Somites
5 Yolk sac



How to describe and classify embryonic development correctly ?

CARNEGIE STAGES OF EMBRYOGENESIS



Andrew Carnegie (1835-1909)

Carnegie Institute of Science

- Carnegie's steelworks in Pittsburg
- sold to JP Morganovi – US Steel
- filantrop
- 1902 - Carnegie Institute in Washington
- Department of Embryology

CARNEGIE HALL

EMBRYOLOGY IN 30s - NEW AVENUES PAVED

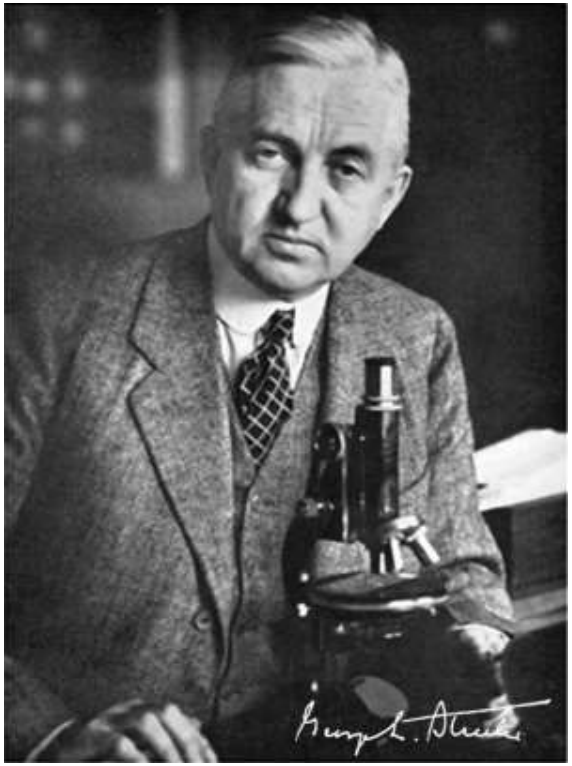
CARNEGIE SCIENCE | Embryology

Franklin Mall

- beginning of 20th century
- age of emrbyo or its absolute size are not suitable for developmental classification

George Streeter

- 1942 „horizonts“



Jan Florián

- 1927 – first in the world to describe early human embryogenesis

BRNO EMBRYOLOGY IN 1930s - TOP TIER

International Institute of Embryology

London, 2-5 August 1938

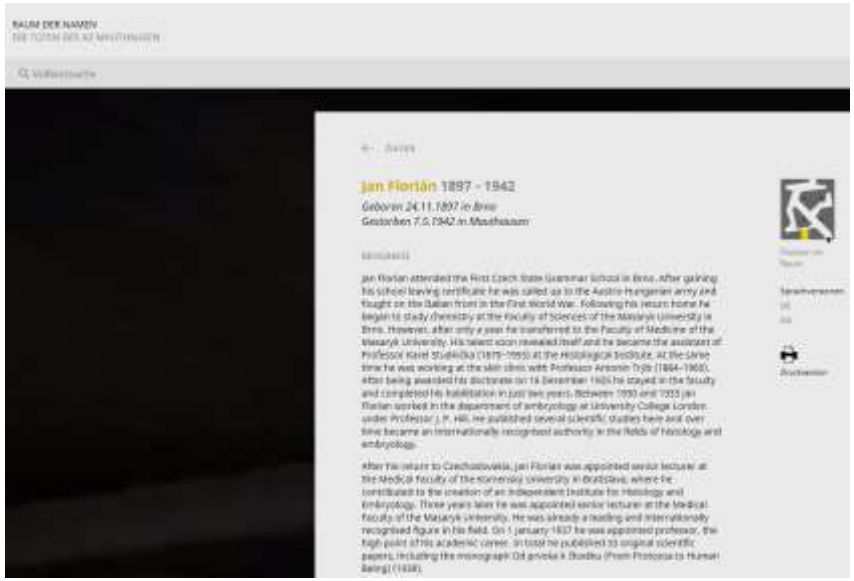
Jan Florián

G.L. Streeter

prof. Jan Florián 1897 - 1942

- full professor of histology and embryology at LF MU and the last dean of LF MU before WWII
- distinguished scientist
- writer, poet
- active in anti-Nazi resistance, executed in 1942

[Further reading: Brno Encyclopedia](#)



and far more than a woman of her age should have attempted; but she would not and, indeed, could not ease up; there is no respite for a farmer in war-time. In the last year, when her head man was away ill for months, she still managed to carry on. It wore her out. She had served her generation in so many ways to the utmost of her powers, that when illness struck her, she was left with too little strength to fight for herself.

So this great-hearted woman became a war casualty, laying down her life for her country in the Battle of the Home Front. G. L. Elles.

Prof. Jan Florian

It is with feelings of deep regret that we have to record the death at the hands of the Gestapo of the distinguished Czech embryologist, Prof. Jan Florian, dean of the Medical Faculty in the Masaryk University, Brno, on May 7, 1942. By his researches on early human embryos, Prof. Florian had established for himself an international reputation as an embryologist and had made many friends among the anatomists in England and other allied countries.

The following notice is contributed by his teacher and friend, Prof. F. K. Studnička, of the Charles University, Prague.

During the first year of their occupation of Bohemia and Moravia, the Germans closed all the universities and colleges, seven in number, and subjected their staffs to the harshest treatment. Many of them were sent to concentration camps and died there; others were executed. The Masaryk University at Brno was especially brutally treated. The institutes were looted and some twenty members of the staff were murdered, among them Jan Florian.

Florian was born in Brno in 1897. He served as a conscript in the Austrian Army throughout the First World War, and in 1919, when the Masaryk University was founded, he was among its first medical students. In 1923 he graduated M.D. and became assistant in the Institute of Histology and Embryology. In 1928, he was admitted *Docent*, and in 1933 was appointed professor of histology and embryology in the Comenius University, Bratislava. Eventually he returned to Brno as professor in succession to me.

Early in his career, Florian became interested in embryology, and with the help of Dr. O. Bittmann succeeded in forming a fine collection of well-preserved human developmental material. He devoted himself to the study of the early stages in his collection and, in papers published between 1927 and 1930, added much to our knowledge of early human development. We need only mention here his work on embryos Bi I (1927) and TF (1928) and his redescriptions of the Fetzer embryo, with Fetzer (1930), and the Beneke embryo, with Beneke (1930–31).

In the years succeeding 1930, Florian, with the aid of grants from the Rockefeller Foundation, was enabled to spend several long periods of study-leave at University College, London, where as honorary research assistant he continued his investigations. He participated actively in the meetings of the Anatomical Society and contributed several valuable papers to its *Journal*, and he also collaborated with Prof. J. P. Hill in the description of an early human embryo (1931) and in a study of early embryonic stages of *Tarsius*. He was co-author, with Prof. Frankenberger, of a text-book of embryology, the first to be published in the Czech language, and author of a popular work entitled "From Protozoon to Man" (also in Czech).

Florian was an excellent mathematician, and utilizing the principles of projective geometry, he perfected a method of graphic reconstruction which has proved of great value in the interpretation of serial sections of embryos in which the sectional plane is oblique to the median plane of the embryo. He also designed an improved type of micro-manipulator.

In 1938, Florian was elected a member of the Institut International d'Embryologie, an honour he greatly appreciated. In 1939, he was appointed dean of the Medical Faculty in the Masaryk University, but he had barely assumed the duties of the office when, in November of that year, the universities were closed by the Nazis. Florian for a while tried to carry on with his work, and at the same time was active in alleviating the hardships of the families of those who had been persecuted. Eventually in October 1941 he himself was imprisoned by the Gestapo, at first in Brno, but at the end of January 1942 he was deported to the notorious concentration camp of Mauthausen, near Linz. There he was kept in solitary confinement, tortured and finally shot on May 7, along with seventy-six other prisoners.

Such was the end of an ardent and noble-hearted patriot and a gifted man of science. His death at the early age of forty-five is an irreparable loss to his beloved country and to the science he did so much to advance. F. K. Studnička.

Mr. J. H. Driberg

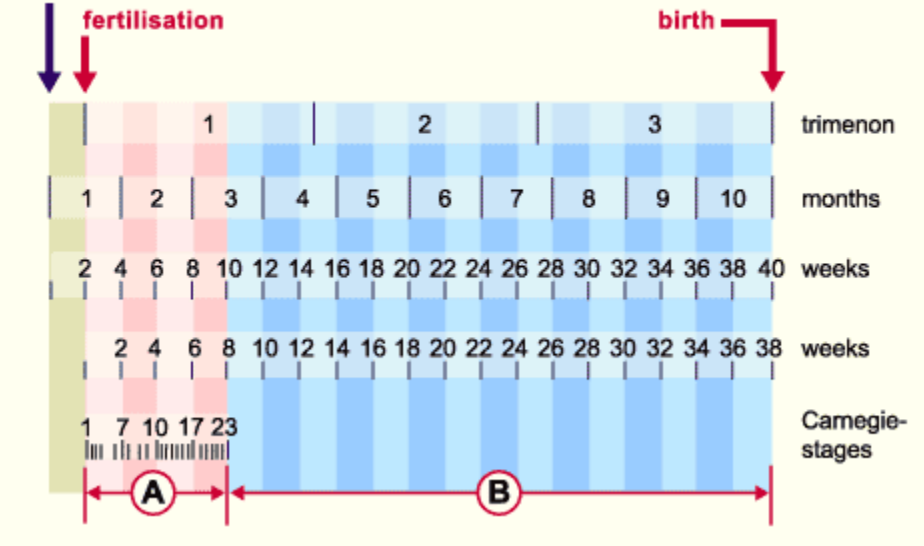
The death of Mr. Jack Herbert Driberg on February 5 will come as a shock to his many friends and admirers. Born in April 1888, he was educated at Lancing College and Hertford College, Oxford, and in 1912 joined the Uganda Administration, spending nine years in it before he was transferred to the Sudan Political Service, from which he was invalided on pension in 1925. In 1923 he had written his well-known book, "The Lango: A Nilotic Tribe of Uganda", and thus established his claim as an anthropologist, and, after a training in the London School of Economics, was appointed to a lectureship in the School of Archæology and Anthropology in Cambridge. He held this post until the outbreak of the War in 1939, when he resigned and volunteered for war-work and was posted to the Near East; at the time of his death he was concerned with Middle East affairs in the Ministry of Information.

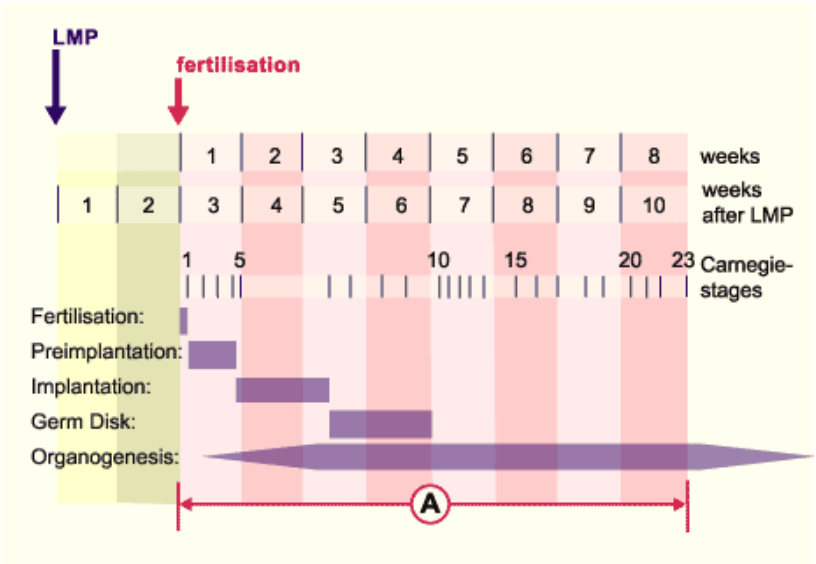
Driberg was a man of exceptional ability, and on the sound foundation of Greats at Oxford, developed a keen sense of the right word and turn of phrase which made his "People of the Small Arrow" (1930) and "Ngato, the Lion Cub" (1933), to mention only two of his works, such delightful reading. As a teacher he was inspiring, and devoted much time to helping his students. His appreciation of the value of anthropology to administrators in the Colonial Service, gained by his experience in Uganda and the Sudan, did much to inspire Colonial probationers who attended his lectures and talked with him in his rooms with the practical value of the science in relation to their future work, and seeds were sown in successive generations of probationers which to-day are bearing fruit.

He was a good linguist and spoke a number of African languages, and this, coupled with his magnificent physical strength and power of endurance,

CARNEGIE STAGES OF EMBRYOGENESIS

- 23 stages
- embryonic age based on inner and outer morphology and size of embryo
- O'Rahilly and Müller (1987) – embryonic or Carnegie stages

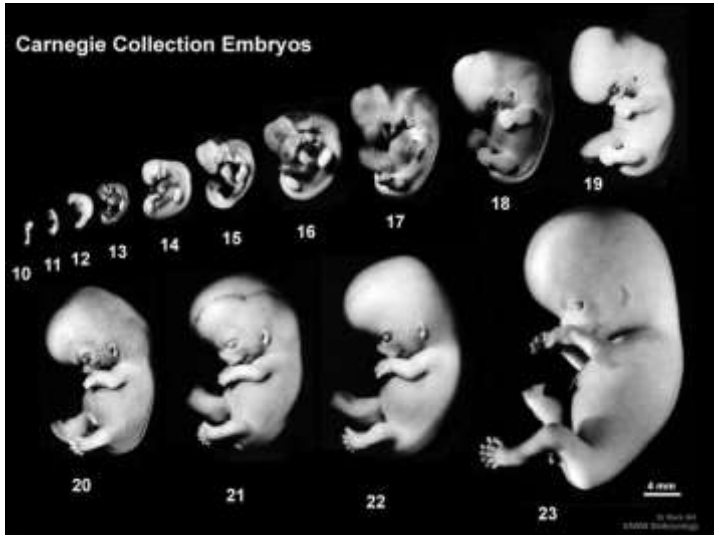


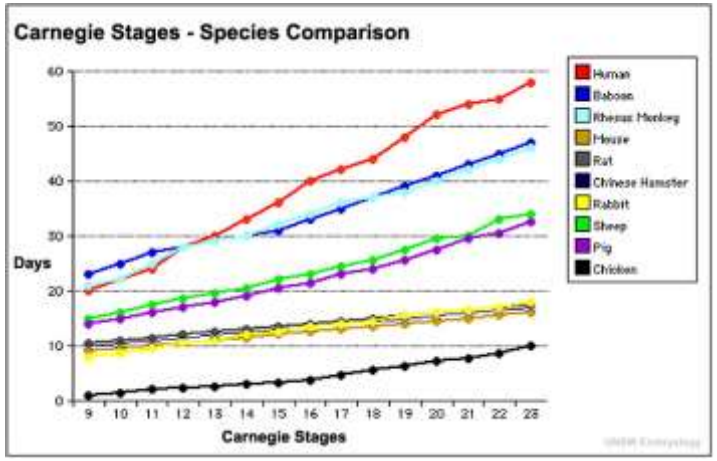


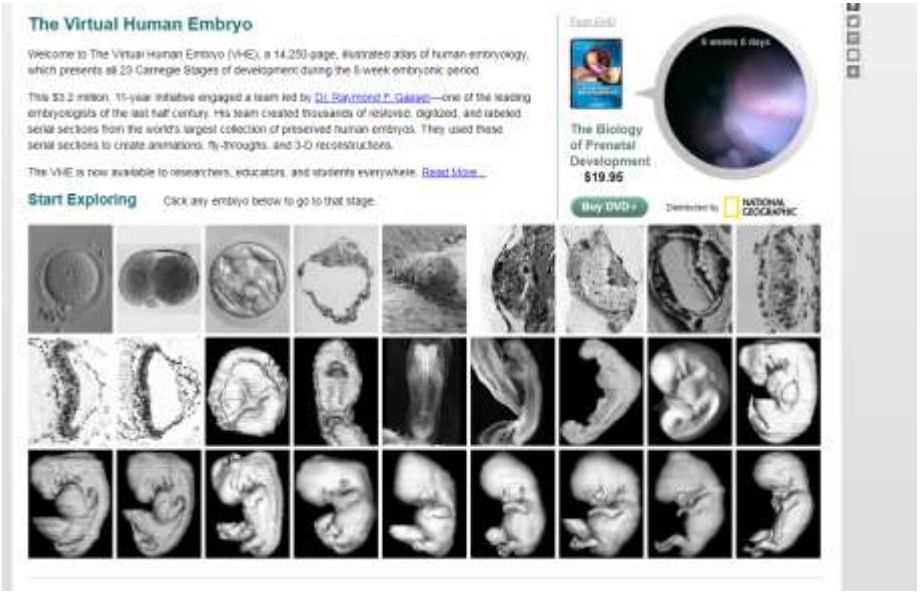
https://embryology.med.unsw.edu.au/embryology/index.php/Main_Page

CARNEGIE STAGES OF EMBRYOGENESIS

- O'Rahilly and Müller (Carnegie) stages







http://www.prenatalorigins.org/virtual-human-embryo/

EMBRYONIC DEVELOPMENT

week 4-6

- Mesoderm segmentation
- Primitive gut
- Esophagotracheal diverticulum
- Heart (starts beating day 22-23)
- Limb buds
- Primary brain vesicles, closing of neuropores
- Differentiation of neural crest
- Origin of thyroid and anterior pituitary
- Ectodermal placodes, optic vesicle
- Liver diverticulum
- Septum transversum

- Segmentation of mesoderm continues
- Posterior pituitary
- Heart septation begins
- Lung buds branch - pseudoglandular stage of lung development
- Cochlea grows
- Lens vesicle, nasal placodes
- Fourth brain ventricle forms
- Pharyngeal arches, ridges and pouches
- Limb buds grow
- Hematopoiesis in liver
- Retinal pigment

- Derivatives of endodermal pharyngeal pouches (parathyroid, thymus)
- Adrenal gland
- Heart and lungs descended to thorax
- Innervation of limbs, differentiation of myoblasts
- Face development – maxillary and mandibulary processes, palatine, choans
- Telencephalon stratifies – archicortex, paleocortex and neocortex. Choroid plexus
- Rotation of stomach
- Pancreatic diverticula fuse

EMBRYONIC DEVELOPMENT

week 8

- Secretion from endocrine pancreas
- Growth of liver, growth and luminization of bile ducts
- Ossification of limbs begin
- Development of brain nuclei

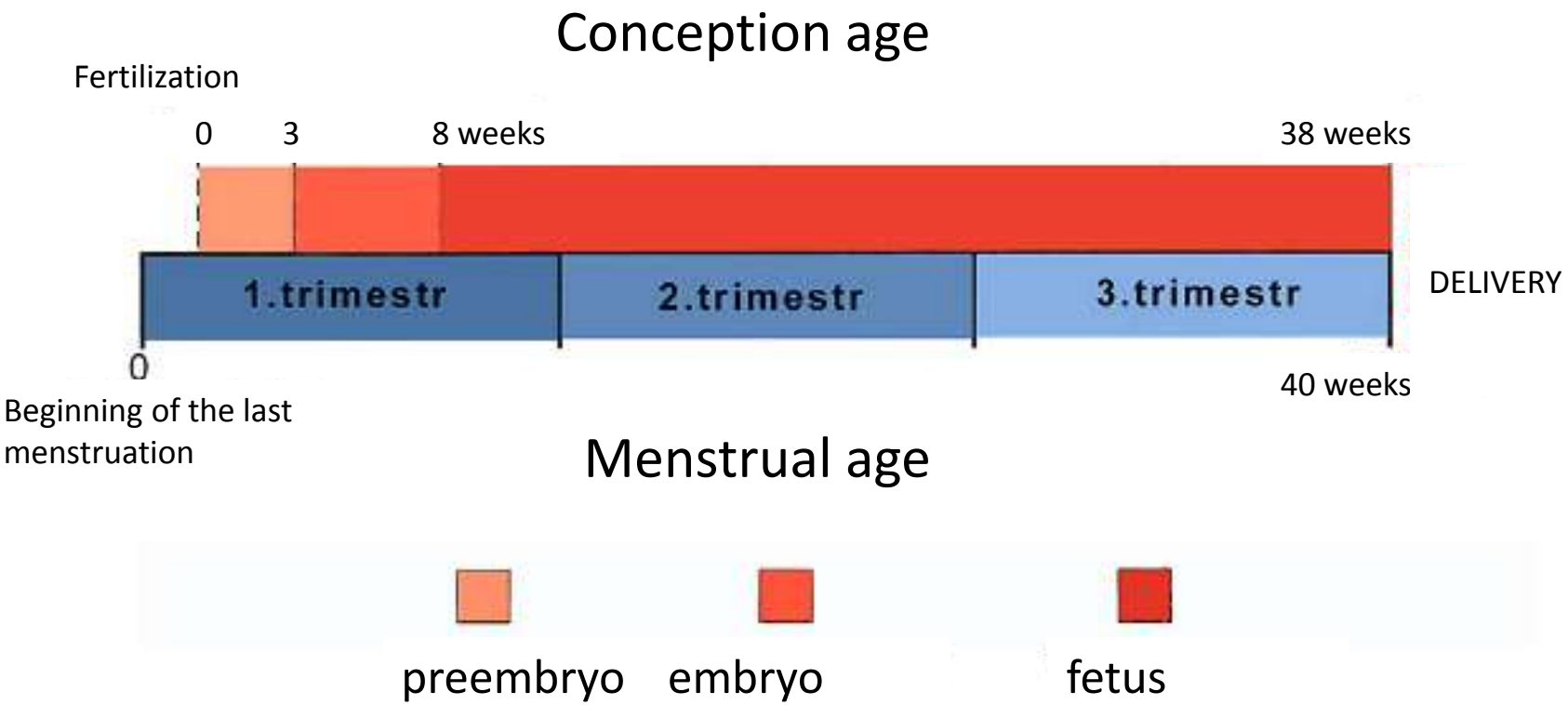
- Joints of upper and later lower limbs allow rotation
- Fingers grow
- Stratification of cerebellar cortex
- Perforation of anal membrane
- Herniation of intestinal loops
- Testes produce testosterone
- Nose, meatus, eyelids, developer, external ears start to grow
- Backbone - 33-34 cartilaginous vertebrae
- Embryonic tail diminished

LENGTH OF PREGNANCY

280 days (= 40 weeks = 10 lunar months) from the first day of the last **menstruation**

266 days (= 38 weeks) **from ovulation** (gestation age)

Calculation of term: First day of the last **menstruation + 1 year– 3 months + 7 days**



FETAL DEVELOPMENT

month 4-5

- Fetus swallows amniotic fluid – necessary for GIT development
- Rapid growth of head (non-proportional to rest of body)
- Eyelids fuse
- Ossification centers visible by ultrasound examination
- Development of external genitalia
- Kidneys produce urine, other organs start to work
- Skeletal muscles innervated
- Physiological umbilical hernia, in 12th weeks reposition of intestinal loops

- Rapid growth of fetus
- Ossification of skeleton
- Face growths, mandible visible
- Apparent external genitalia

FETAL DEVELOPMENT

month 5-9

- Limbs growth
- Mother feels fetal movements
- Vernix caseosa, lanugo
- Short hairs and eyelashes
- Fetus reacts to sound and later to light
- Lungs start to produce surfactant
- Limit of viability

- Eyelids open
- Wrinkled skin with visible capillaries
- Subcutaneous fat
- Hairs grow
- Maturing of organ systems

- Subcutaneous fat accumulates in limbs
- Smooth, red skin
- Hallmarks of full term fetus

Full term – related to length of pregnancy (menstrual age)

- preterm (<37 weeks)
- full term (38 – 40 weeks)
- after term (>42 weeks) (meconium in amniotic fluid)

Fetal maturity – development of fetus: mature X immature

HALLMARKS OF FETAL MATURITY

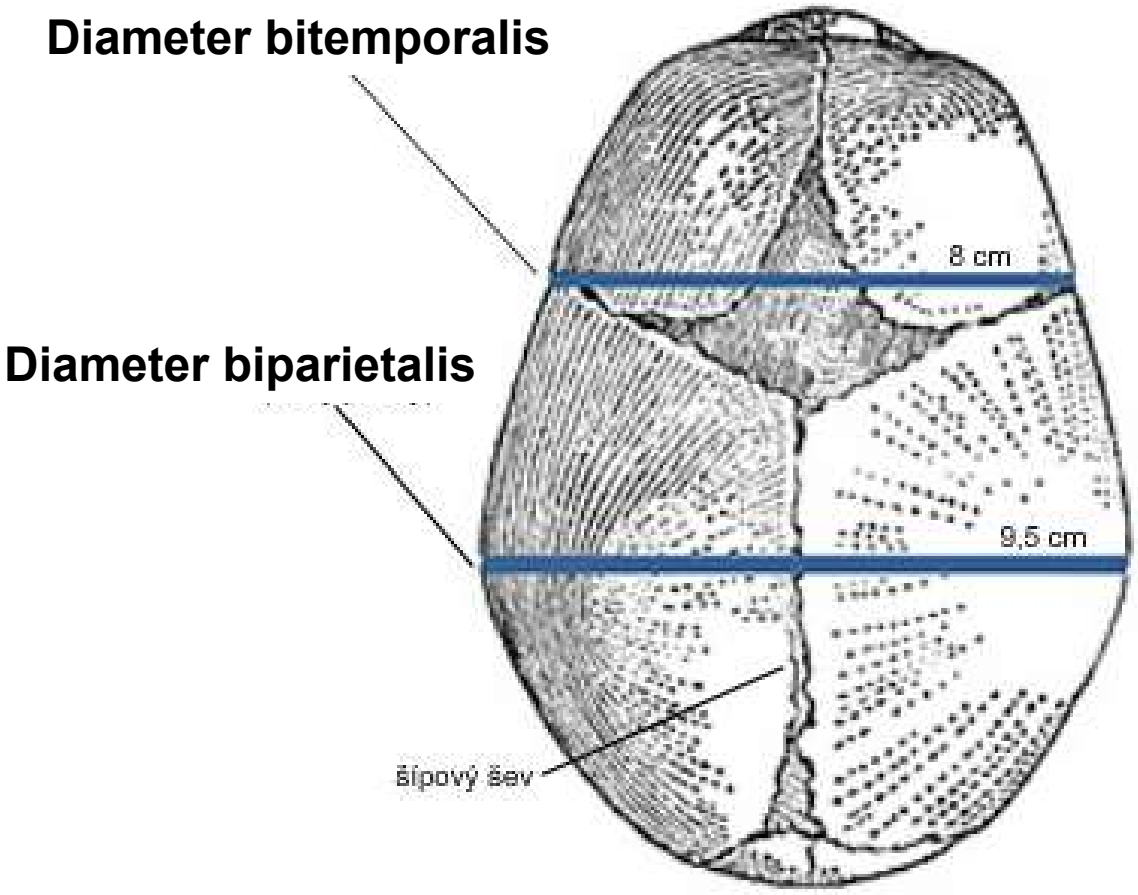
Major:

- **length (50 – 51 cm),**
- **weight** (around **3500 g**, physiological range 2500 - 4000g),
- head sizes
- boys - testes in scrotum, girls - labia majora over labia minora

Minor:

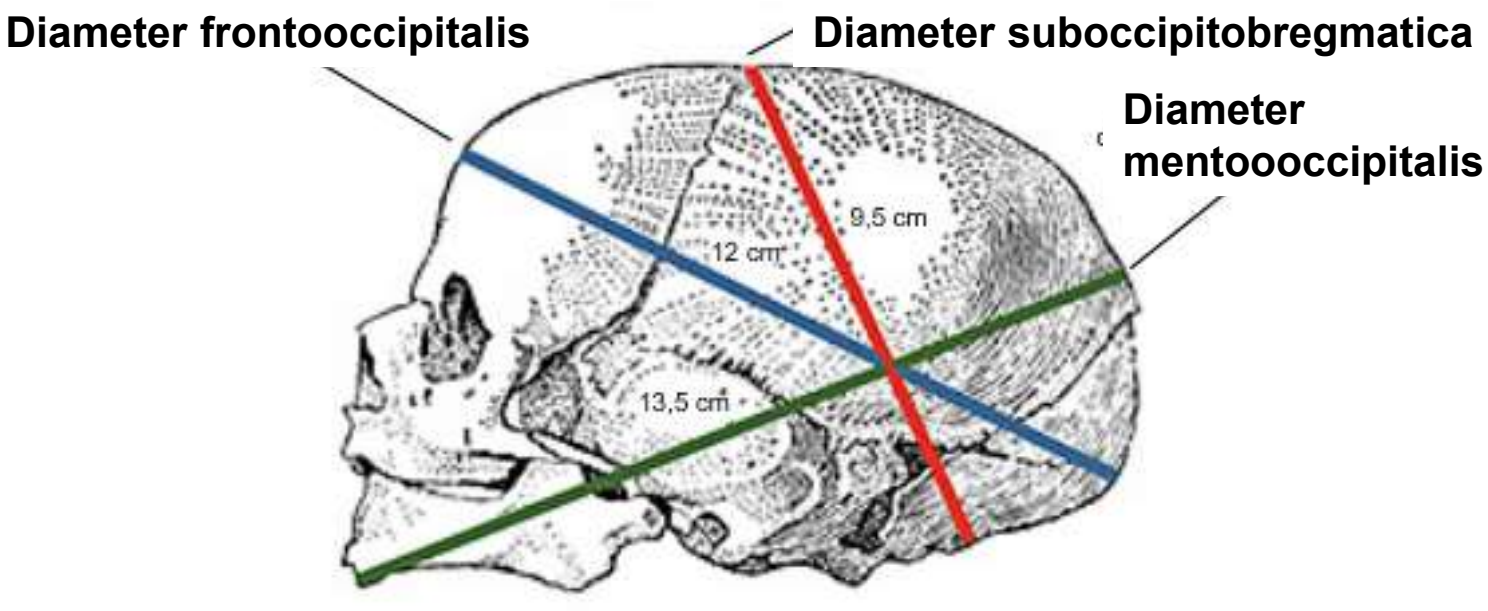
- eutrophic fetus, subcutaneous fat
- skin is not blue (no cyanosis), lanugo remains on shoulders and back,
- eyelashes, hairs several cm long, nails over fingertips
- cranial bones hard, anterior and posterior fontanelle are palpable, and separated
- new born cries and moves (Apgar score)

Diameter bitemporalis – 8,00 cm
(join of the most distant points on sutura coronaria)
Diameter biparietalis – 9,5 cm
(join of midpoints of tubera parietalia)



Oblique sizes:

- **Diameter frontooccipitalis – 12.0 cm** (join of forehead midpoint and most distant point of occiput)
- **Circumferentia frontooccipitalis – 34.0 cm**
- **Diameter suboccipitobregmatica – 9.5 cm** (join of protuberantia occipitalis externa and midpoint of large fontanelle)
- **Circumferentia suboccipitobregmatica – 32.0 cm**
- **Diameter mentooccipitalis – 13.5 cm** (join of chin midpoint and most distant point of occiput)
- **circumferentia mentoocipitalis – 35 - 36 cm**
- **Diameter biacromialis – 12.0 cm, circumferentia biacromialis – 35 cm**
- (join of acromion – acromion)



RULE OF HASSE

- forensic medicne

3. – 5. lunar month: length in cm = square of month
6. – 10. lunar month: length in cm = months multiplied by 5

Lunar month	Length of fetus[cm]
3	9
4	16
5	25
6	30
7	35
8	40
9	45
10	50

FETUS IN UTERUS

1. **LIE (*SITUS*)** = relationship of the long axis of the fetus to that of the mother
- longitudinal: (99 %)
- transverse: (1 %) perpendicular axes
- oblique: unstable → longitudinal or transverse position

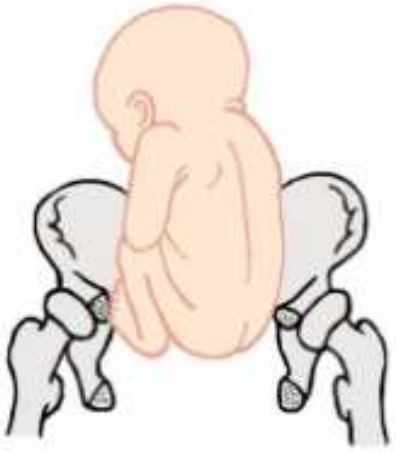
2. **POSITION (*POSITIO*)** = fetal backbone relative to uterus ridge
- **first**= left (back to the left)
- **second**= right (back to the right)
- first/second common/less common

3. **FETAL HABITUS (*HABITUS*)** = relationship of one fetal part to another
- regular = head and limbs in flexion
- irregular = everything else

4. **PRESENTATION (*PRAESENTATIO*)** = that part of the fetus lying over the pelvic inlet; the presenting body part of the fetus.
- occiput (most common)
- vertex, forehead, face (1%)
- breech
- trunk, shoulder

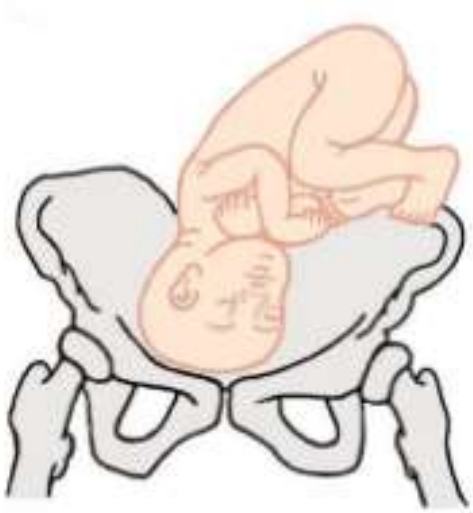
FETUS IN UTERUS

longitudinal - occiput



longitudinal - breech

transverse

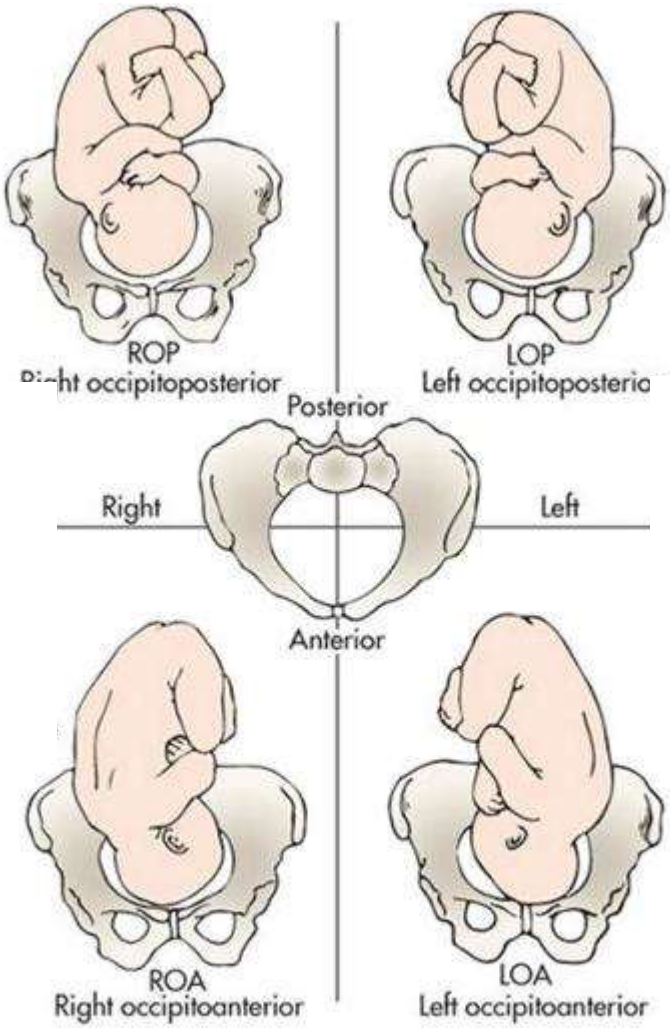


oblique

POSITION OF FETUS

2. COMMON „RIGHT“

1. COMMON „LEFT“



Lie: Longitudinal or vertical
Presentation: Vertex
Reference point: Occiput
Attitude: General flexion

2. LESS COMMON

1. LESS COMMON

HABITUS AND PRESENTATION

HABITUS

irregular (vše ostatní)

regular

PRESENTATION

occiput

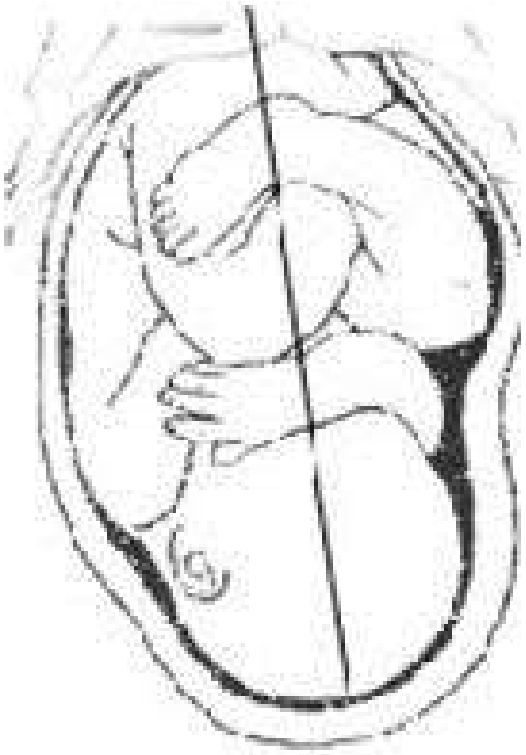
vertex

forehead

face

PHYSIOLOGICAL IMPOSITION OF FETUS IN UTERUS

- LIE LONGITUDINAL - HEAD FIRST
- POSITION FIRST COMMON
- HABITUS REGULAR
- PRESENTATION - OCCIPUT

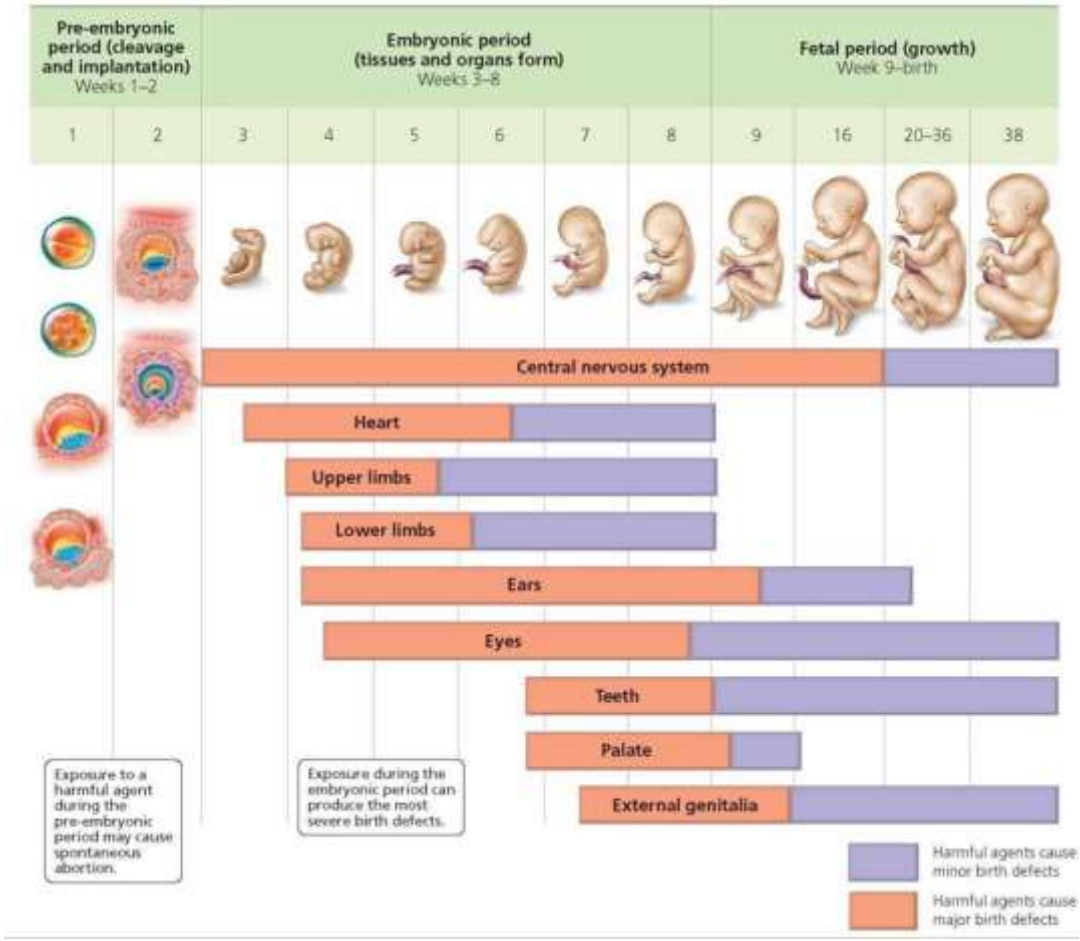


INTRODUCTION TO TERATOLOGY

- Congenital disorders – due to abnormal developmental events
- Genetic (inherited) or nongenetic (external) causes
- Teratogens

- Critical developmental periods

- Life style (alcohol, smoking, drugs)
- Infections (rubeola, HIV, toxoplasmosis)
- Lack or abundance of key substances (folic acid × retinoids)
- Chronic diseases (medical treatment)



INTRODUCTION TO PRENATAL DIAGNOSTICS

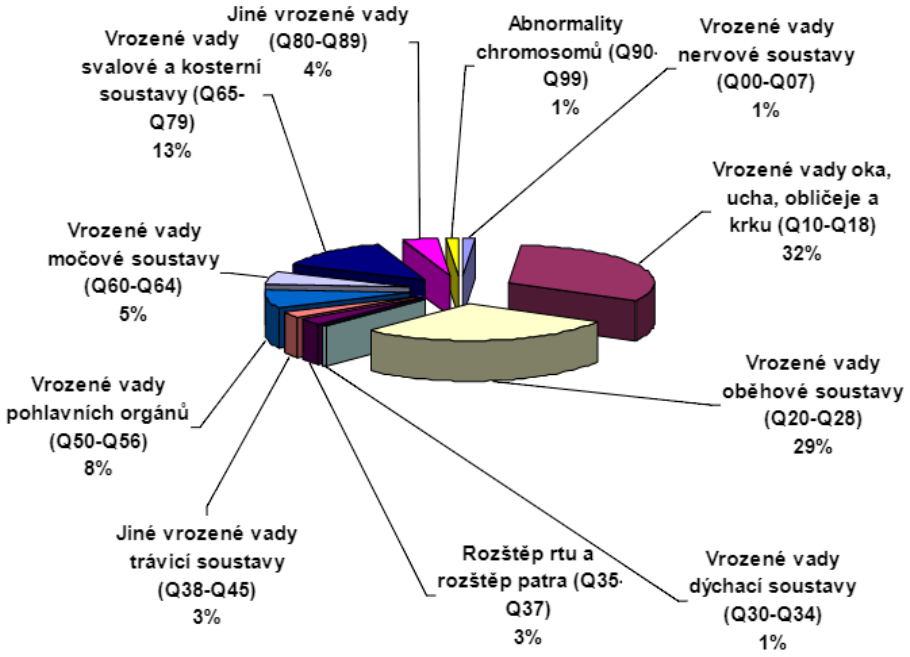
- Interdisciplinary care – biochemistry, genetics, gynecology and obstetrics, neonatology – parts of fetal medicine

- Revealing high risk pregnancies, access to preventive and therapeutic care

- Preventing delivery of fetuses with severe congenital malformations
- Support of delivery of genetically high-risk babies
- Planning and providing clinical care

- Genetic counselling
- Biochemical and ultrasound screening
- Karyotyping and DNA diagnostics
- Clinical diagnostics

- Indication:
- congenital disorders in family
- positive screening in 1st or 2nd trimester
- abnormal finding by ultrasound
- maternal age (over 35 years)



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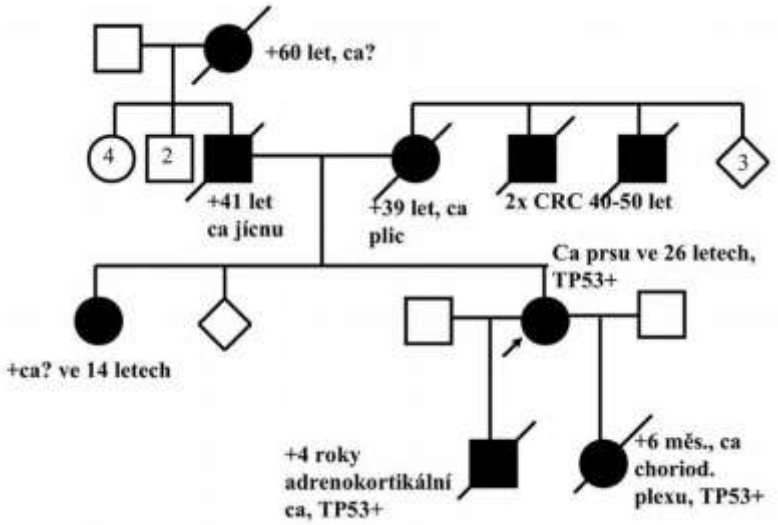
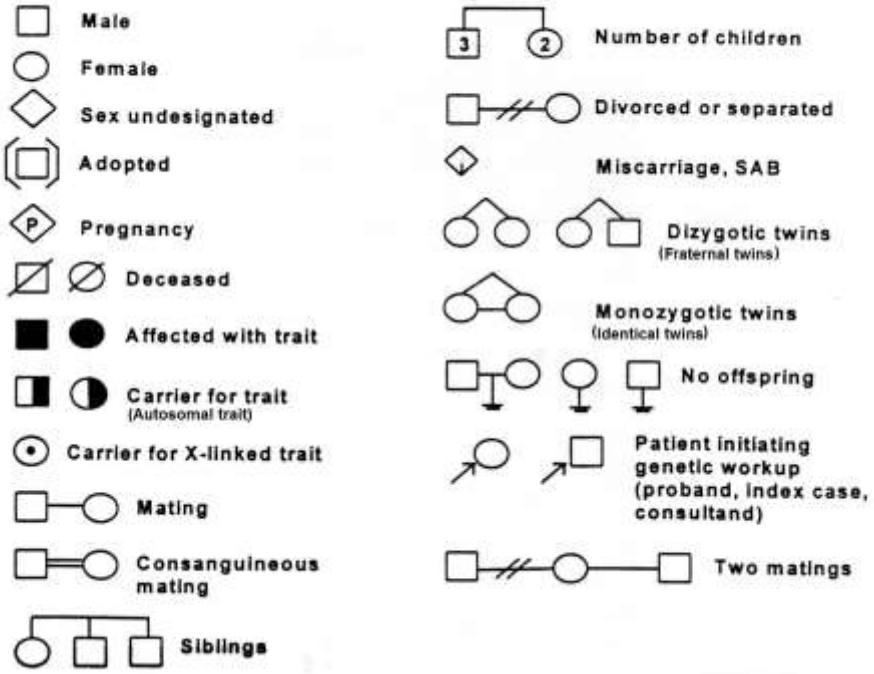
GENETIC COUNSELING

- Anamnesis (case history)
- Preconception counselling
- Explaining of examination results, causes, clinical symptoms, therapeutic options
- Minimization of risk of repeated disease
- Providing diagnosis and information for free choice
- Providing precise diagnosis and risk estimation
- Providing care during pregnancy and later





NONDIRECTIVE
ALL EXAMINATIONS AND PROCEDURES ARE VOLUNTARY

BIOCHEMICAL SCREENING

- Non invasive
- Revealing high risk pregnancies – chromosomal aberrations and clefts
- **Screening is not a diagnostics** → further examinations (amniocentesis, karyotype, US)

- Tests between weeks 14-16 („TRIPLE test“)
- low sensitivity and specificity (50-60%), high false positivity (70%)
- AFP, E3, hCG
- chromosomal aberrations, abnormal closing of neural tube, defects of body walls

- Combined screening in week 11-13
- chromosomal aberrations – Down: 47,XY,+21, Edwards: 47,XY,+18, Patau 47,XY,+18
- US –nuchal translucence, NT
- PAPP-A, hCG (multiplies of median, MoM)
- age included in algorithm
- output: screening positive vs. negative (limit 1:100)

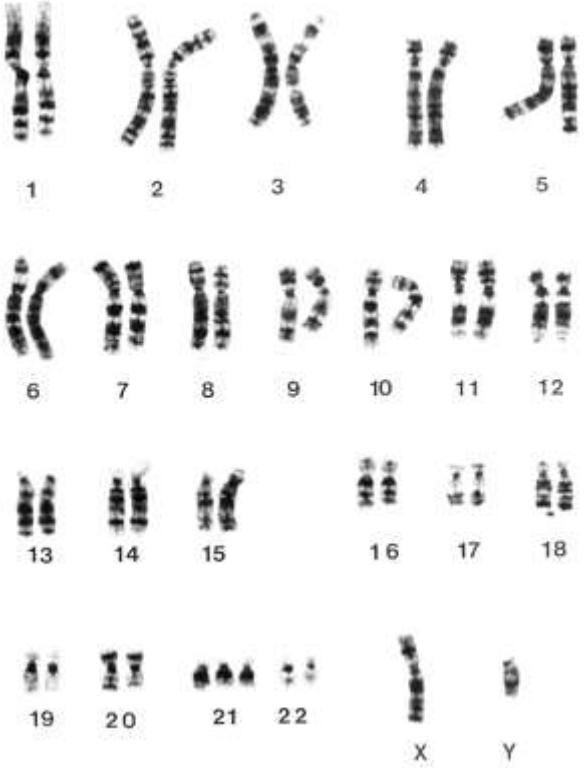
INVASIVE DIAGNOSTICS

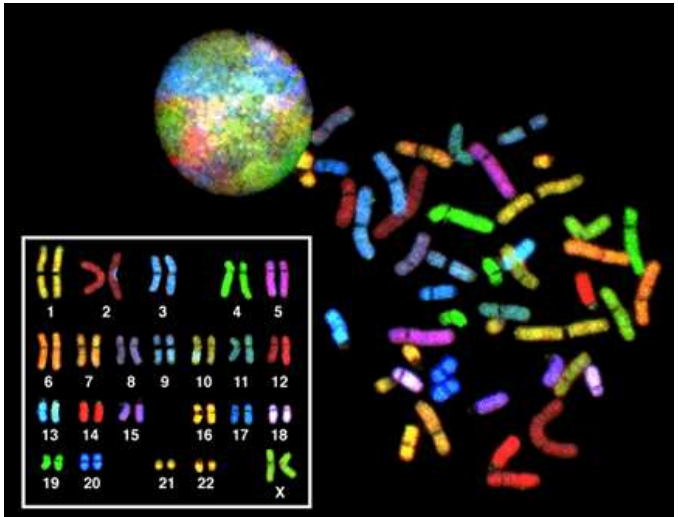
- Amniocentesis
- 16th-20th week
- US controlled amniotic fluid aspiration
- Cell culture, karyotype
- Risk of miscarriage 0.5-1%

- Chorion villus biopsy
- 10th-13th week
- Karyotype, molecular genetic examination
- Risk 0.5-1%

- Cordocentesis
- 22nd week
- Sampling of venous umbilical blood
- Now diagnostics and therapy of blood diseases (anemia, infections), or diagnostics in multiple pregnancies
- Risk 1%

- Fetoscopy
- Transabdominally (earlier transcervically)
- Visualization and fetal biopsy
- Risk 3-10%, done rarely





ULTRASOUND DIAGNOSTICS

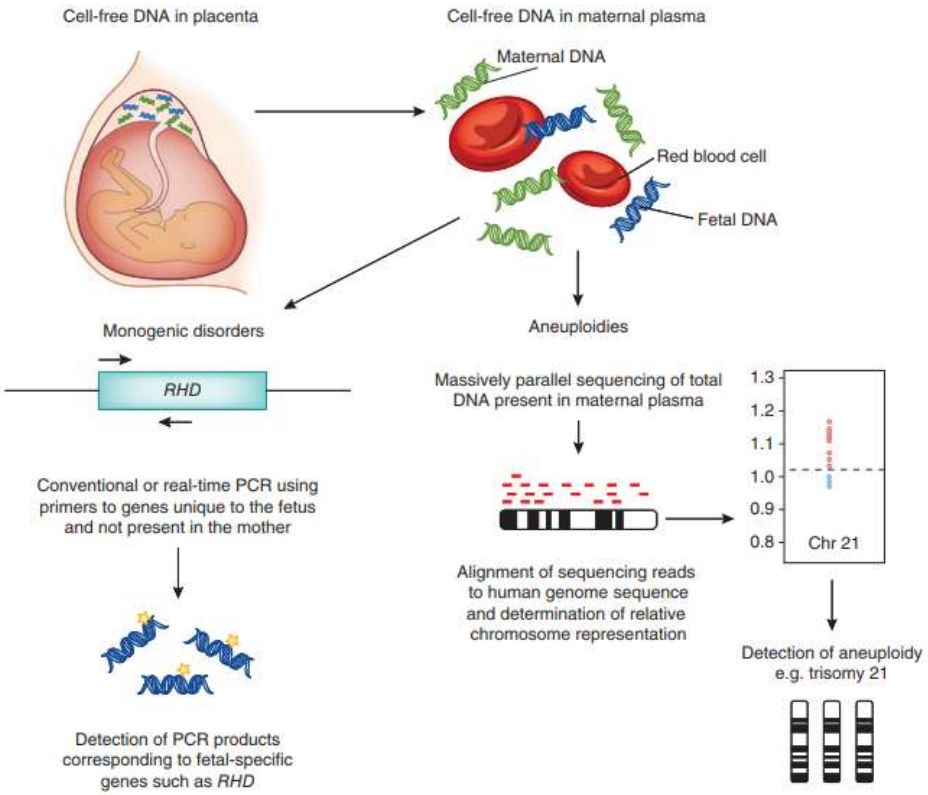
- 6-8th week
- confirmation of pregnancy, heart action
- number of fetuses

- 13-14th week
- nuchal translucence (risk > 3 mm)
- nasal bone (present × absent), **minor markers** (omphalocele, tricuspidal regurgitation, abnormality in ductus venosus flow, enlargement of urinary bladder-megavesica)
- fetal size

- 20-22nd week
- detailed screening
- fetal biometry (biparietal diameter, head circumference, length of femur)
- head and CNS (shape, cavity in septum pellucidum, ventricles, cerebellum, cisterna magna), face (lip, jaws, nose, orbits, profile), heart (action, size, axis, 4-chamber projection, outflow tracts, ...), thorax (pathological structures), abdominal cavity (stomach, intestine, kidneys, urinary bladder, umbilicus and umbilical vessels), backbone, limbs, palms, feet
- placenta, volume of amniotic fluid

- 30th week
- fetal size
- volume of amniotic fluid
- placenta (exclusion of *placenta praevia*)

ADVANCEMENTS IN MOLECULAR GENETICS



Analysis of cell-free fetal DNA in maternal blood
Since 12th week
Massive paralell sequencing (Next-Gen Sequencing)
Common aneuploidies (trisomy 21,13,18)
Monogeneous disorders

SOP-M8	NEINVAZIVNÍ DETEKCE ANEUPLOIDIÍ CHROMOZOMŮ 13, 18 A 21 POMOCÍ MULTIPLEX PCR A MASIVNÍHO PARALELNÍHO SEKVENOVÁNÍ (MPS)

Test Clarigo se značkou „CE", která je nezbytná pro provedení tohoto vyšetření v zemích EU, splňuje základní požadavky Směrnice Rady IVD 98/79/EC pro in vitro diagnostika.

VÝSLEDEK VYŠETŘENÍ:

Chromozom	Stav	Fetální frakce	Předpokládané pohlaví plodu
13	normální	7,1 %	ženské
18	normální		
21	normální		

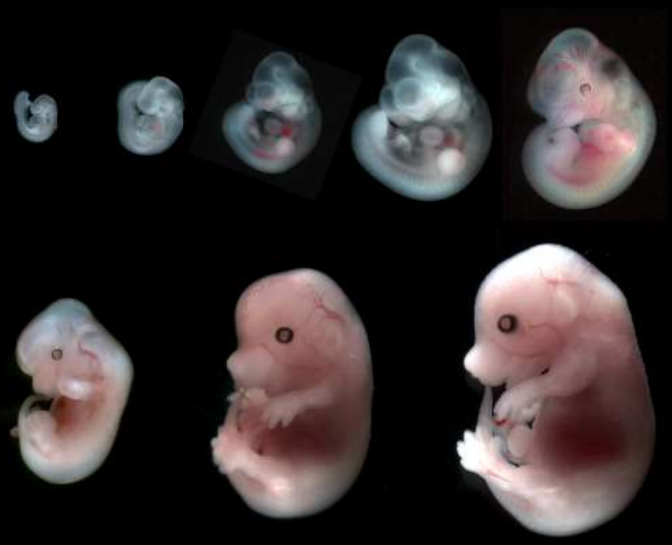
ZÁVĚR:

Analýzou volné fetální DNA cirkulující v krvi těhotné nebylo zjištěno zvýšené riziko aneuploidie chromozomů 13, 18 a 21.

Komentář: doporučujeme genetickou konzultaci.
Pozn: Při patologickém nálezu je výsledek nutné ověřit některým z invazivních postupů (např. odběr plodové vody, choriových klků, kordocentézu s následnou QF-PCR analýzou nebo stanovením klasického karyotypu apod.).

THANK YOU FOR ATTENTION

pvanhara@med.muni.cz
http://www.med.muni.cz/histology




Phallusia mammillata