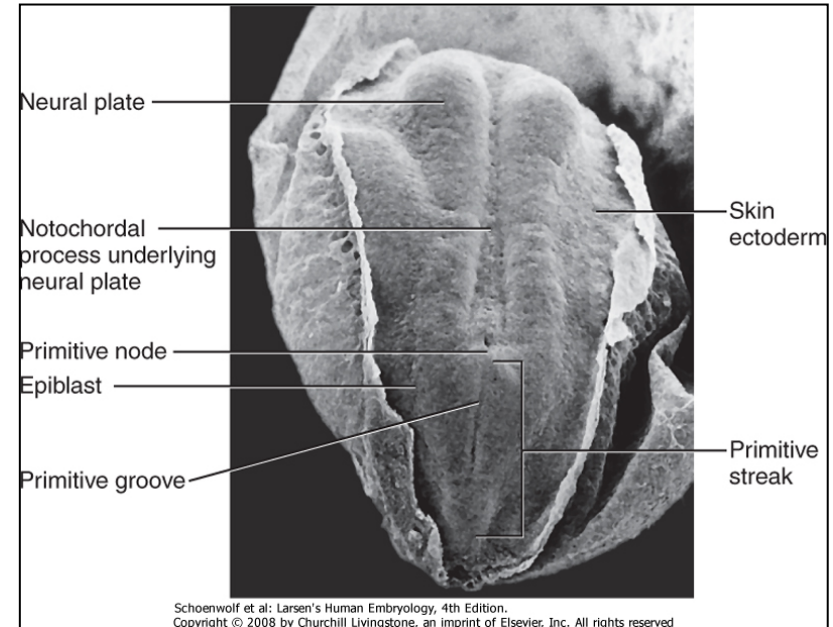
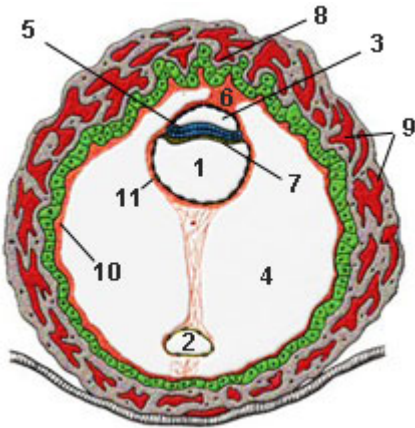


Week 3: gastrulation



Lecture resources:

Chapter 3 and Chapter 4 (pages 82 – 87) of Larsen's Human Embryology
 Chapter 4 and Chapter 5 (pages 65 – 70) of Moore's The Developing Human

<https://embryology.med.unsw.edu.au/embryology/index.php/Lecture - Week 3 Development>

Dr Annemiek Beverdam – School of Medical Sciences, UNSW
 Wallace Wurth Building Room 234 – A.Beverdam@unsw.edu.au

Week 3 Lecture overview

Placentation

Body axes

Gastrulation

Axis formation

Embryo folding

Dr Annemiek Beverdam – School of Medical Sciences, UNSW
Wallace Wurth Building Room 234 – A.Beverdam@uq.edu.au

Week 3 Lecture overview

Placentation

Body axes

Gastrulation

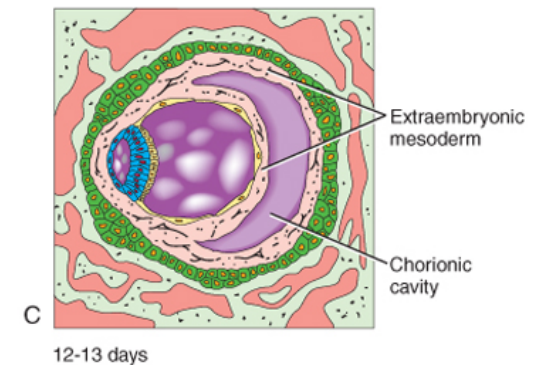
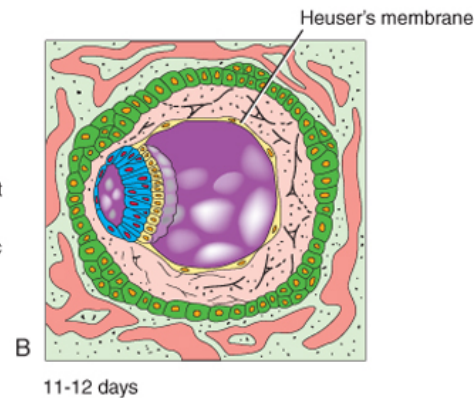
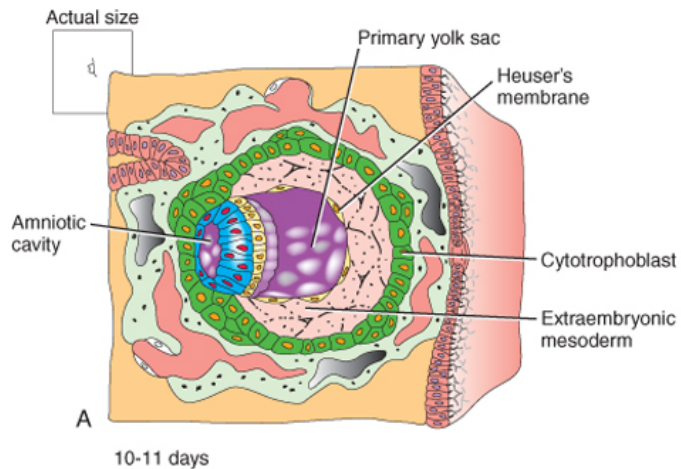
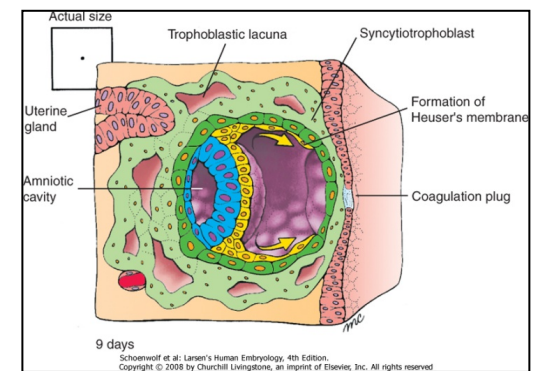
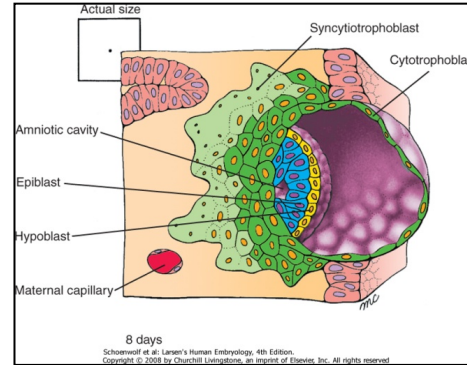
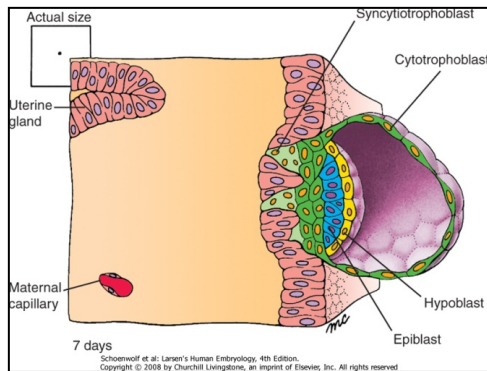
Axis formation

Embryo folding

Placentation

1st week: Nutrients through diffusion
Later: uteroplacental circulation

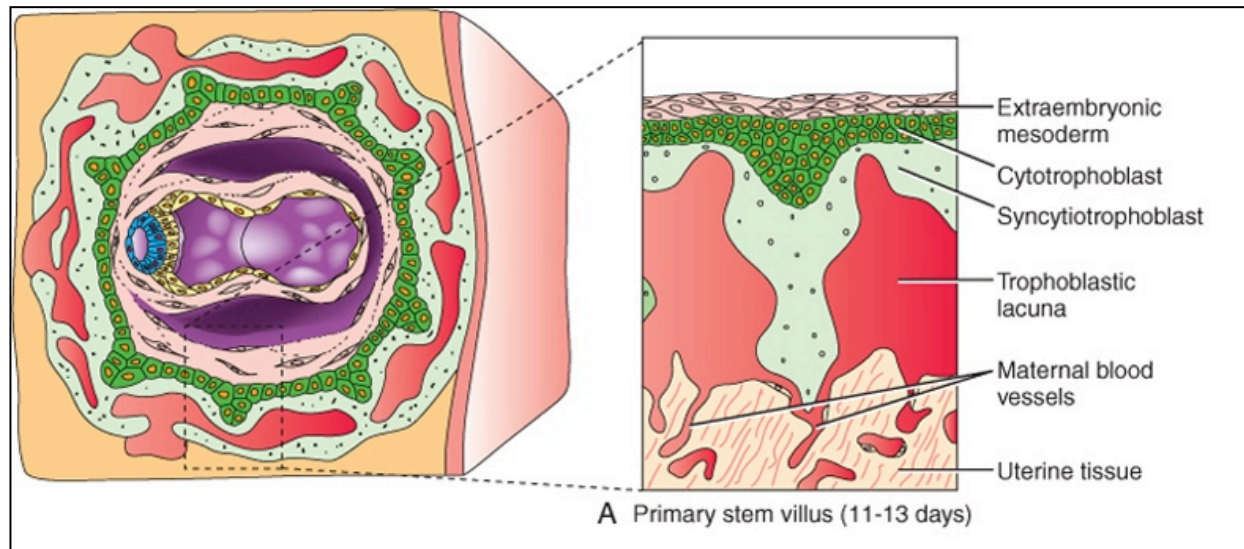
syncytiotrophoblast and cytotrophoblast contribute to placenta formation



Placentation

Day 11-13
Trophoblastic lacunae
Fusion with maternal circulation

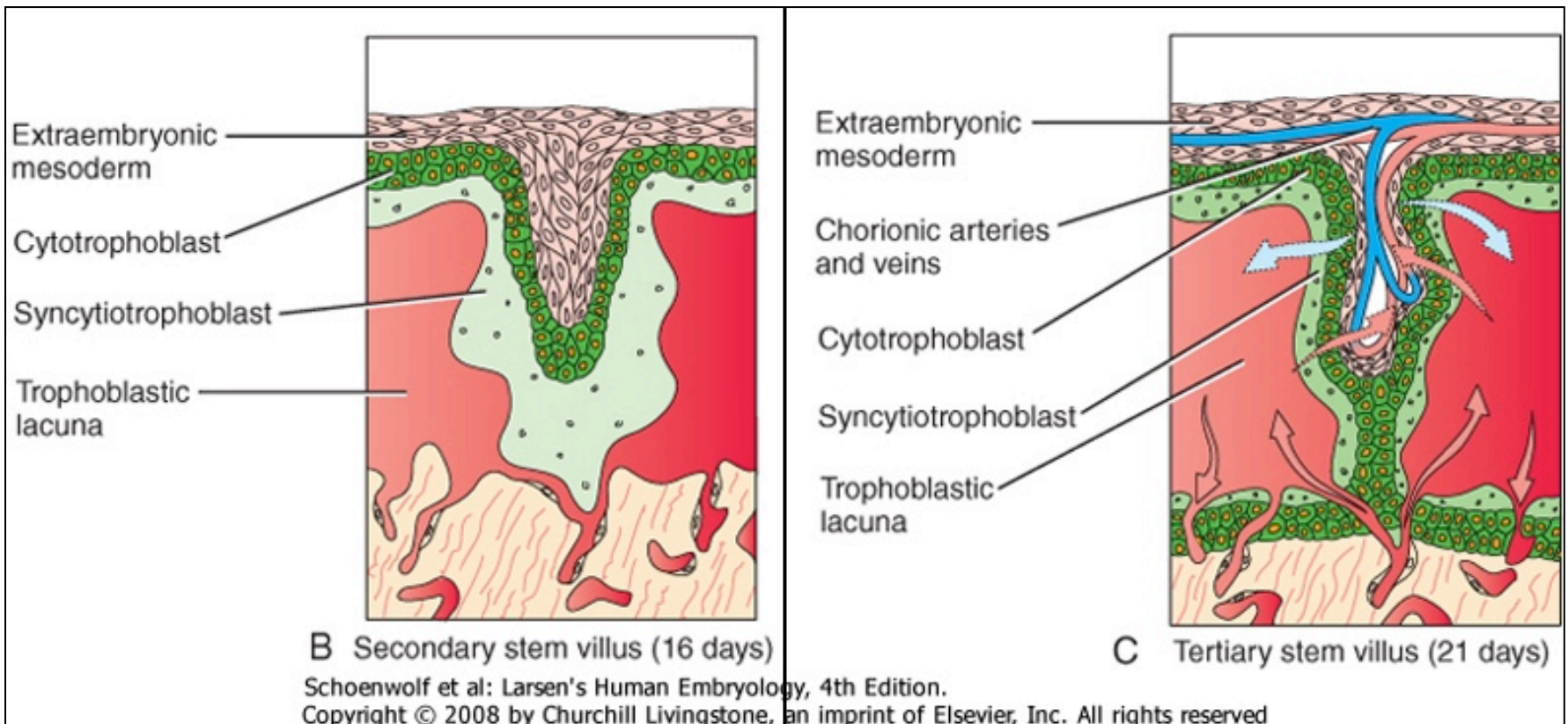
Primary chorionic stem villi formation: Cytotrophoblast projections into lacunae



Placentation

Day 16
Secondary stem villus
Cytotrophoblast projections

Day 21
Tertiary stem villus
Blood vessel development



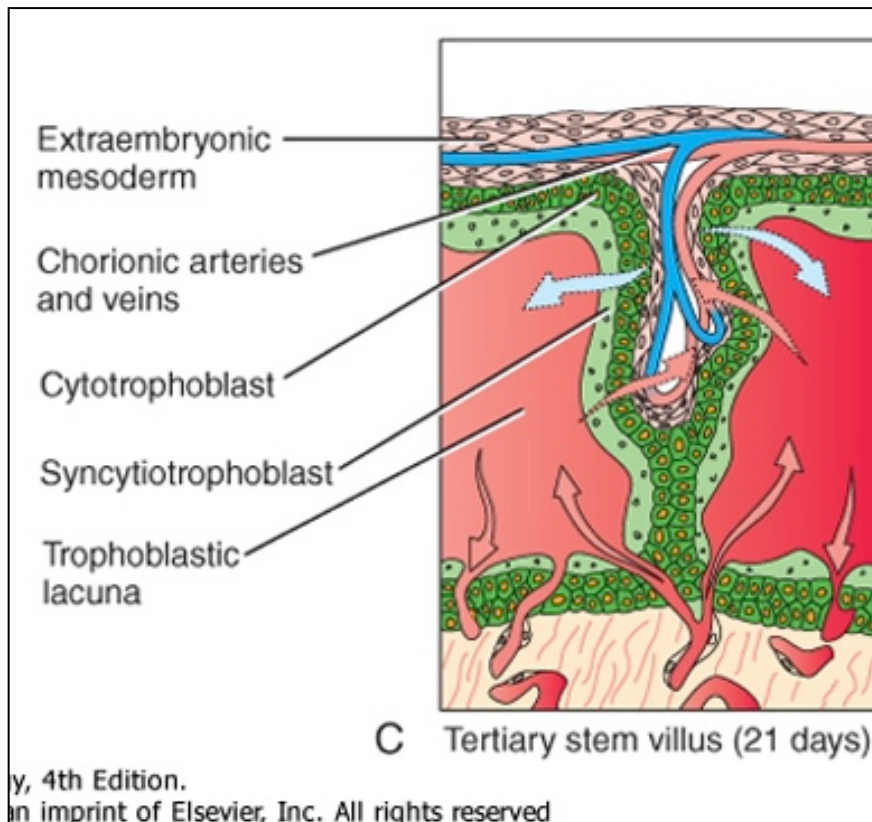
Placentation



Placentation

Placental barrier

No mixing of embryonic and maternal blood



4 separating tissue layers:
 Endothelium
 Connective tissue (EEM)
 Cytotrophoblast
 Syncytiotrophoblast

Week 3 Lecture overview

Placentation

Body axes

Gastrulation

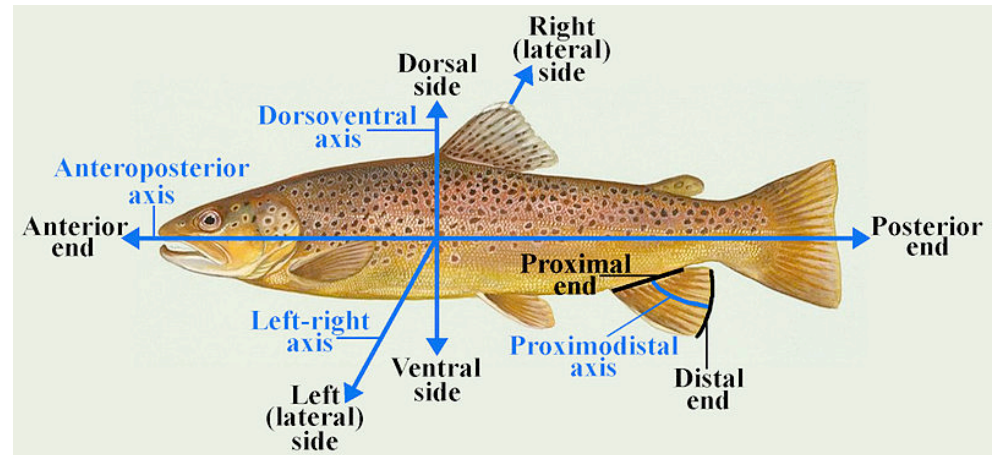
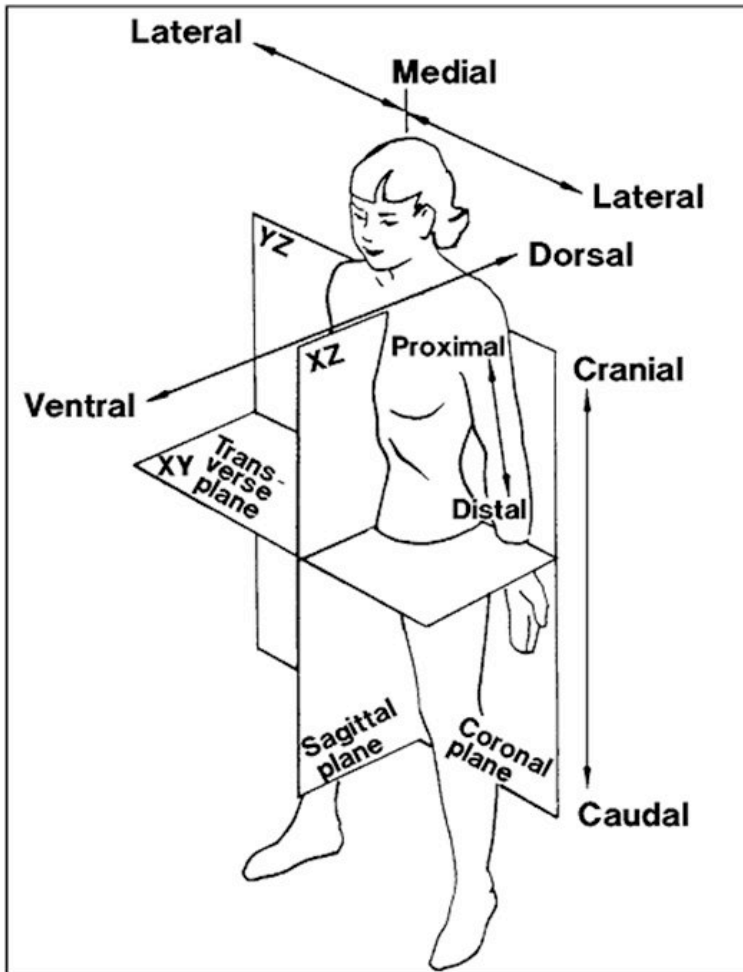
Axis formation

Embryo folding

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Body axes

Anatomical orientation



Week 3 Lecture overview

Placentation

Body axes

Gastrulation

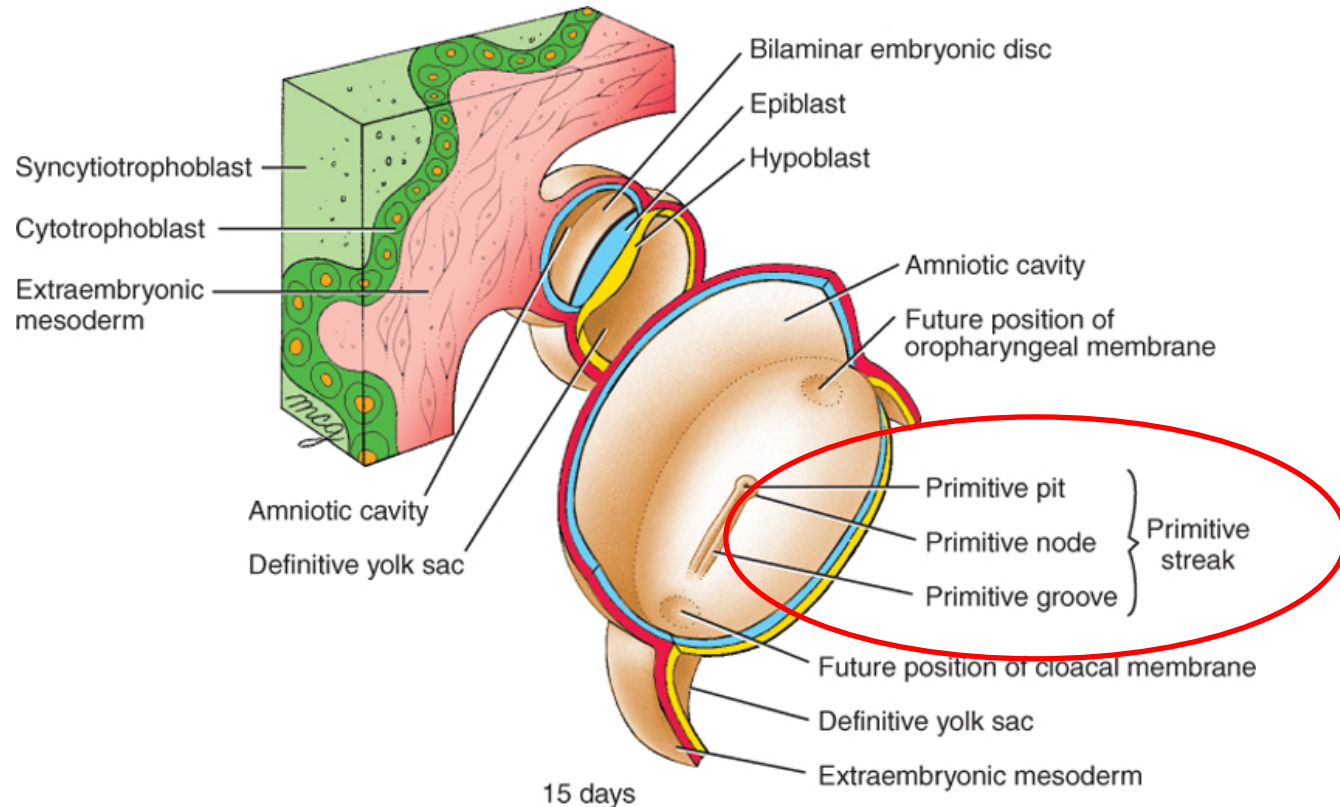
Axis formation

Embryo folding

Gastrulation

Day 15

Formation of third germ layer
Formation of body axes



Gastrulation

Day 16

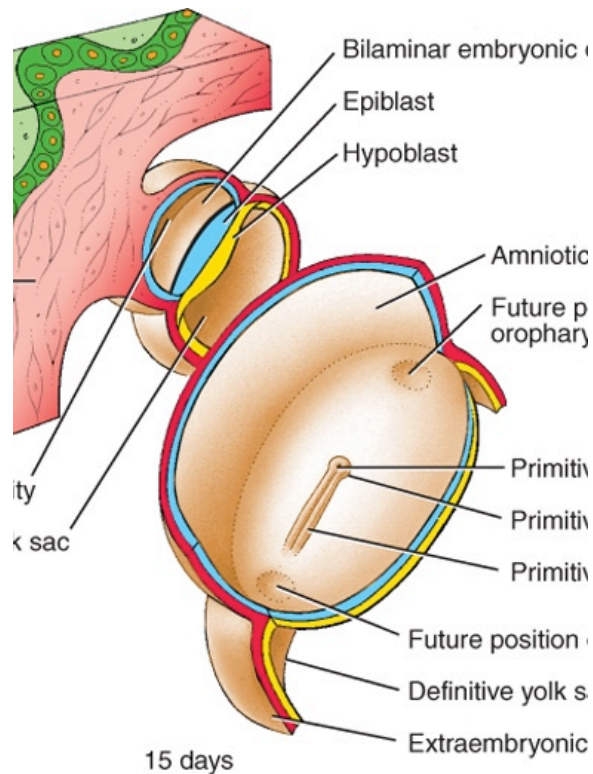
Ingression of epiblast cells: EMT transition

Generation of definitive endoderm

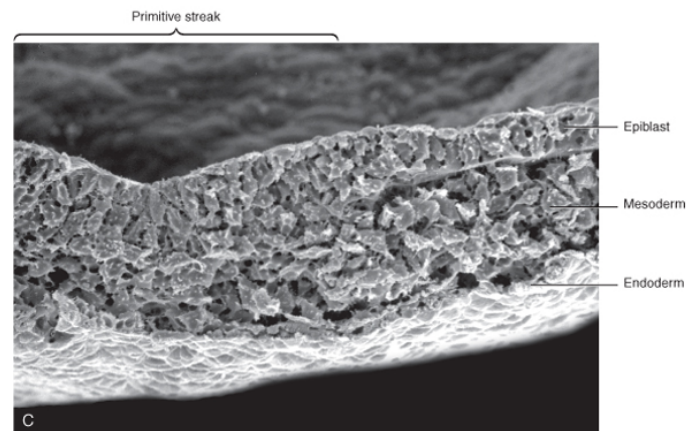
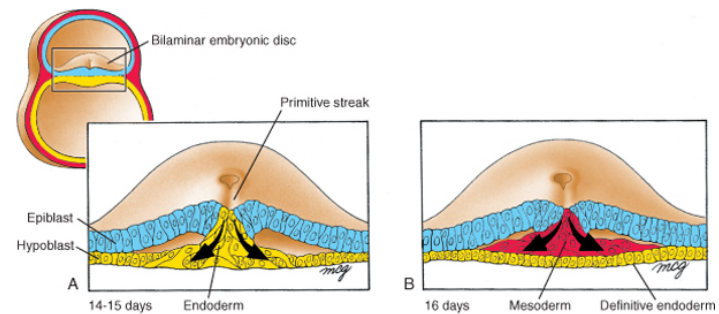
Generation of intra-embryonic mesoderm

Oropharyngeal and cloacal membrane

Embryonic ectoderm



Larsen's Human Embryology, 4th Edition.
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Gastrulation

Day 16

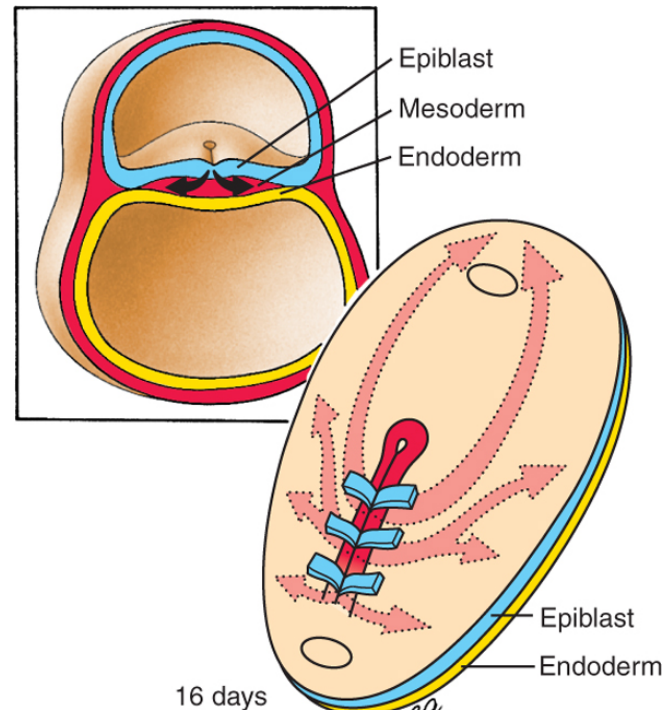
Ingression of epiblast cells: EMT transition

Generation of definitive endoderm

Generation of intra-embryonic mesoderm

Oropharyngeal and cloacal membrane

Embryonic ectoderm



Gastrulation

Day 16

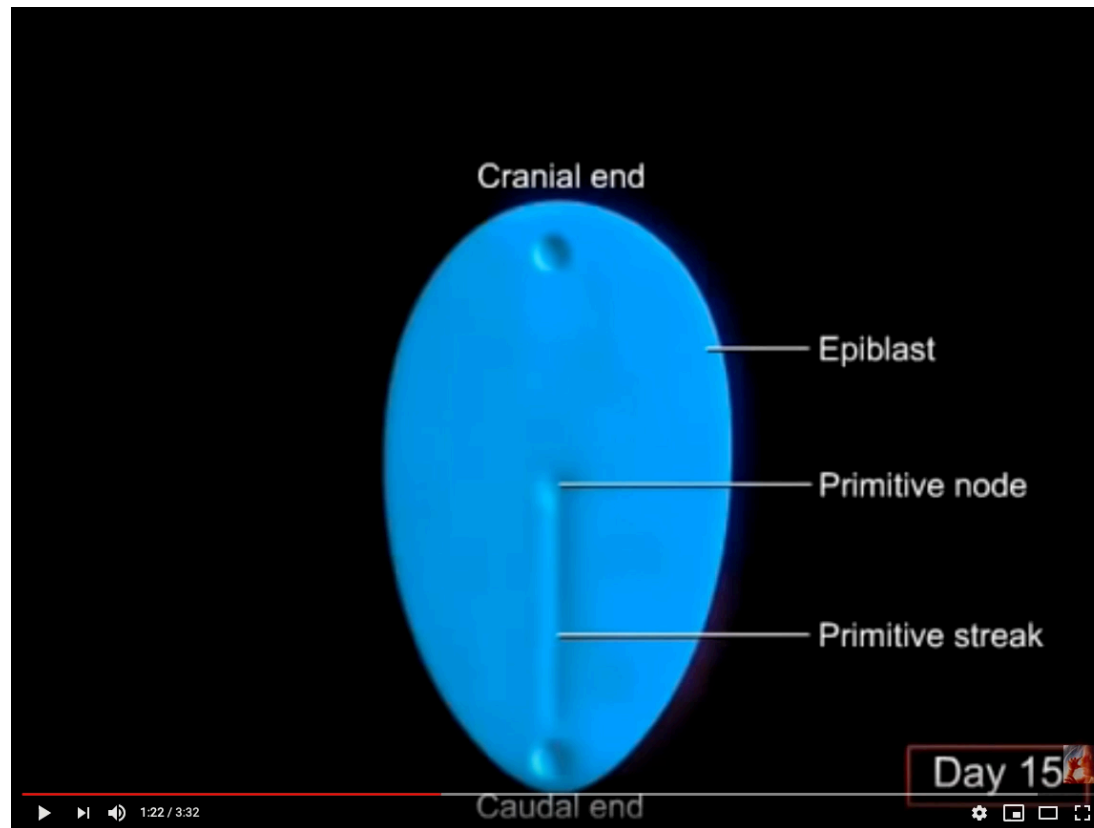
Ingression of epiblast cells: EMT transition

Generation of definitive endoderm

Generation of intra-embryonic mesoderm

Oropharyngeal and cloacal membrane

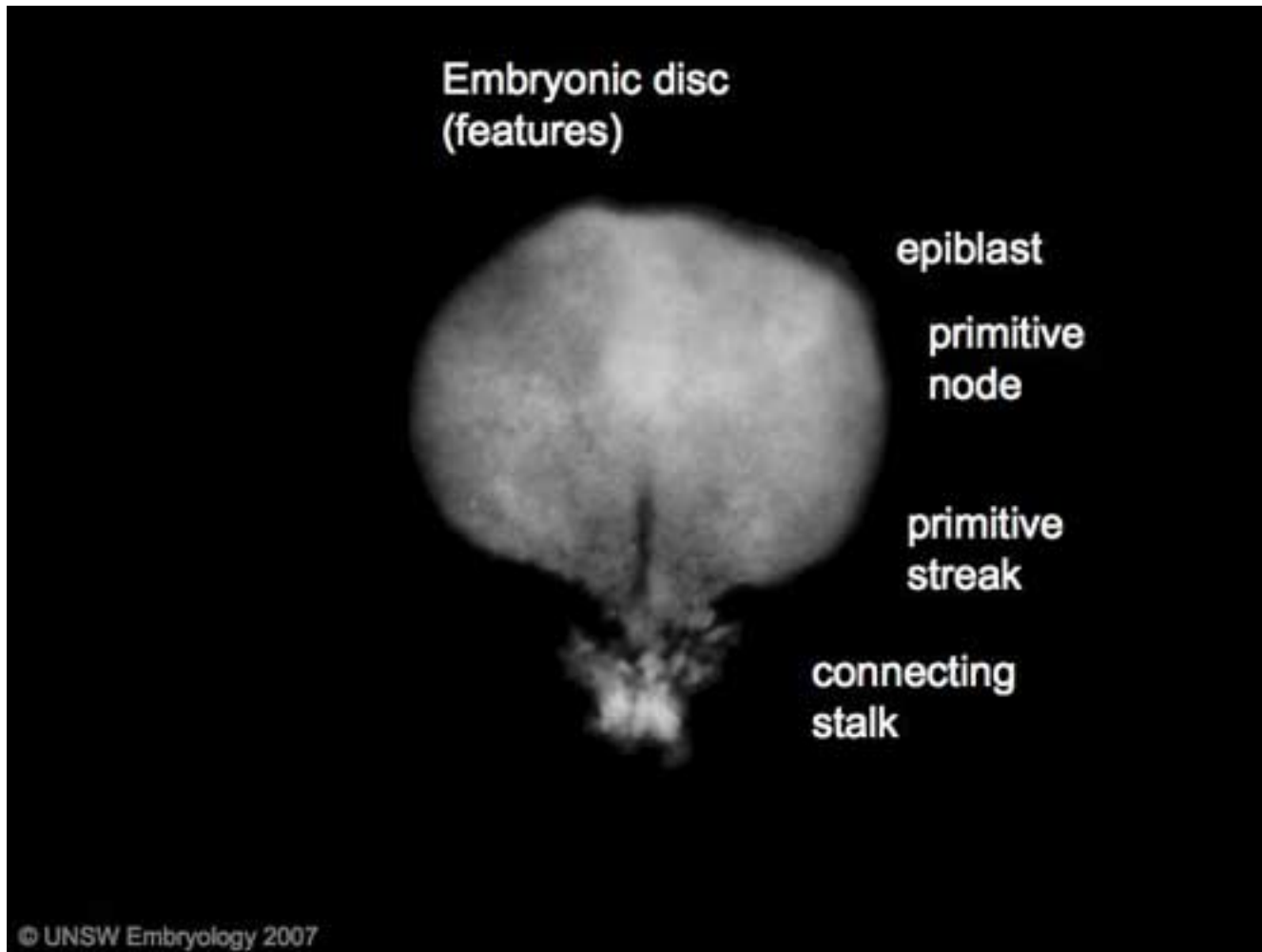
Embryonic ectoderm



Week 3

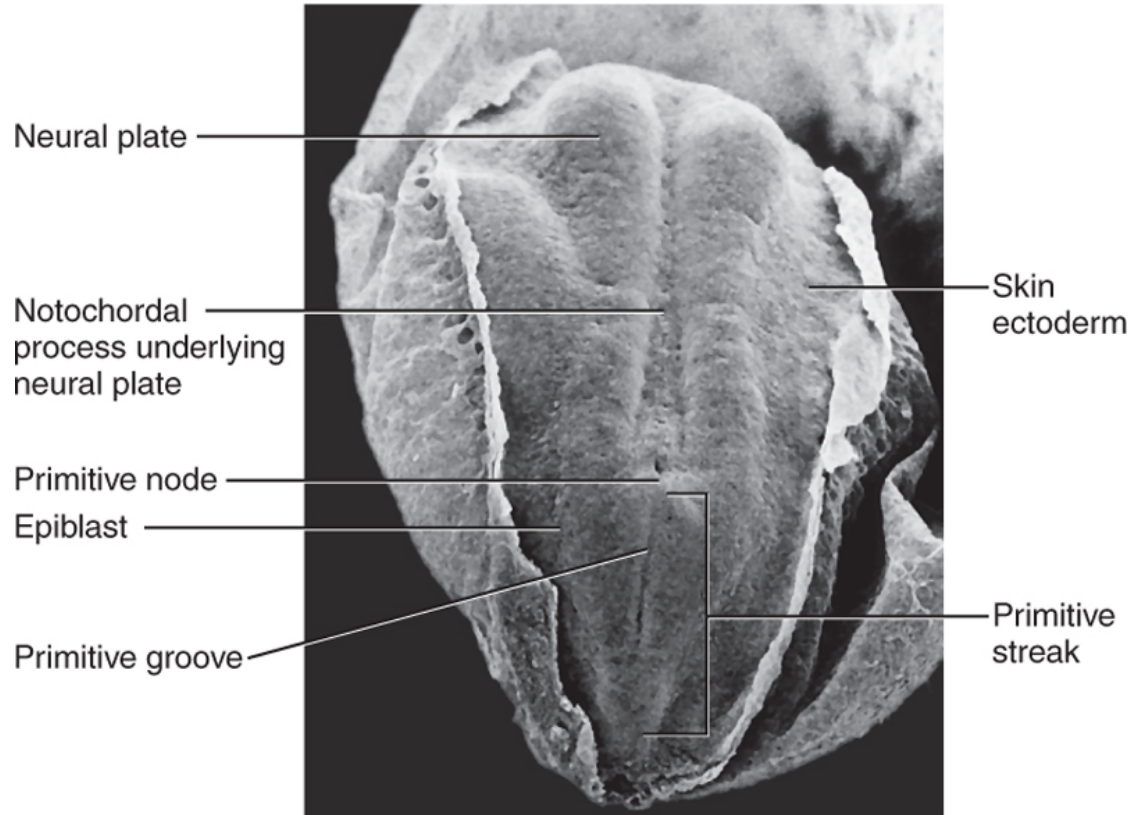
gastrulation

Embryonic disc



Axis Formation

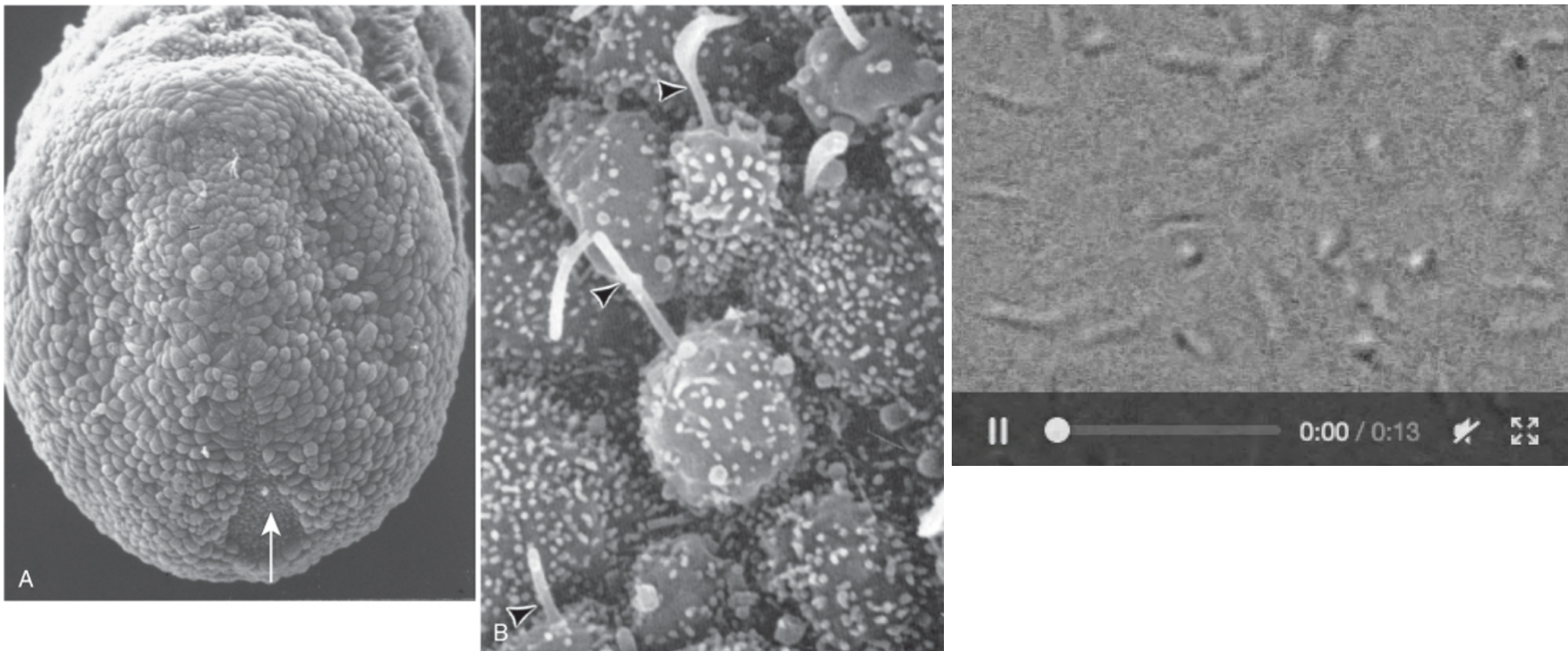
Gastrulation: establishment of 3 body axes



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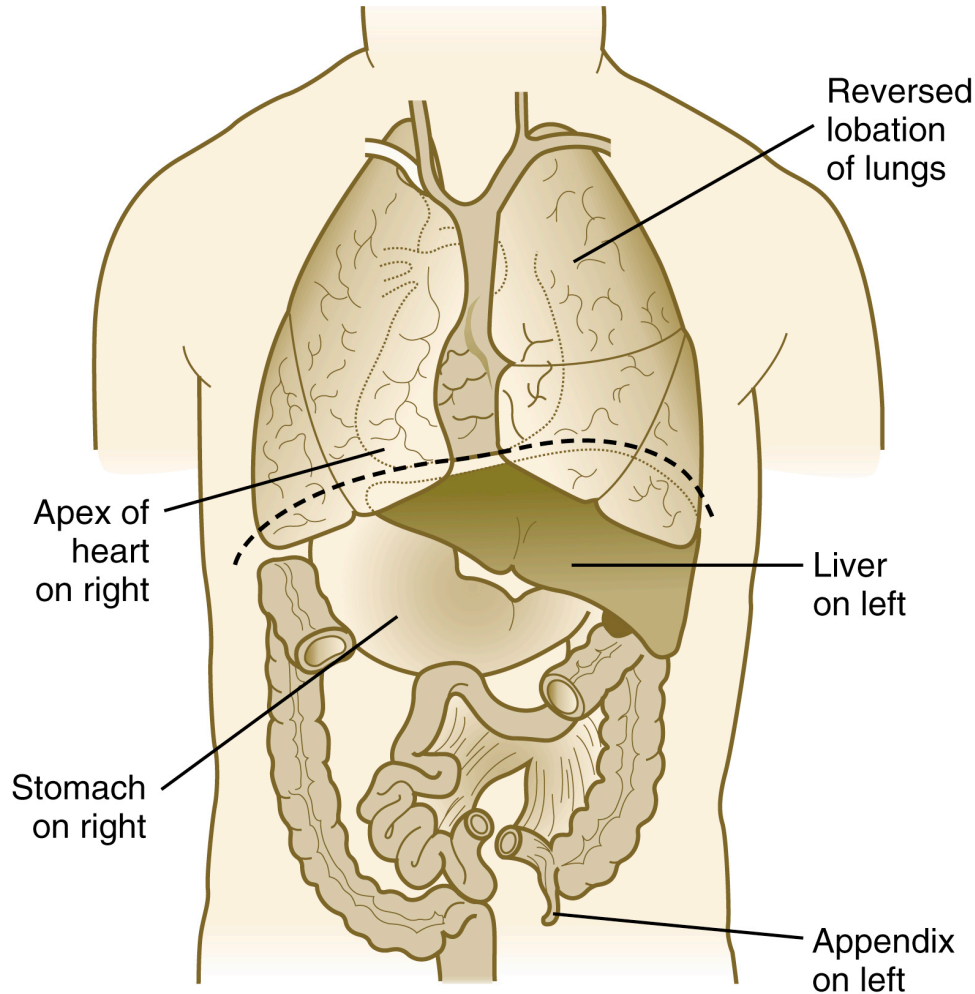
Axis Formation

LR axis generation: Nodal cilia, Nodal/Lefty/Pitx-2 signalling



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Axis Formation



Situs inversus/heterotaxy

Major visceral organs are mirrored
1:10,000 births

No major symptoms or complications

Etiology:

Disturbed nodal current ->

Disturbance of LR axis ->

LPM patterning abnormality ->
organ formation reversed

Gastrulation

Epiblast forms 3 germ layers:

- Ectoderm: epithelium (previous epiblast)
- Mesoderm: mesenchymal layer (embryonic connective tissue)
 - Endoderm: epithelium

Hypoblast:

- replaced by definitive endoderm

Gastrulation:

Endproduct of gastrulation: trilaminar embryo

Ectoderm (Neural crest)

brain, spinal cord, eyes, *peripheral nervous system*
epidermis of skin and associated structures,
melanocytes, cranial connective tissues (dermis)

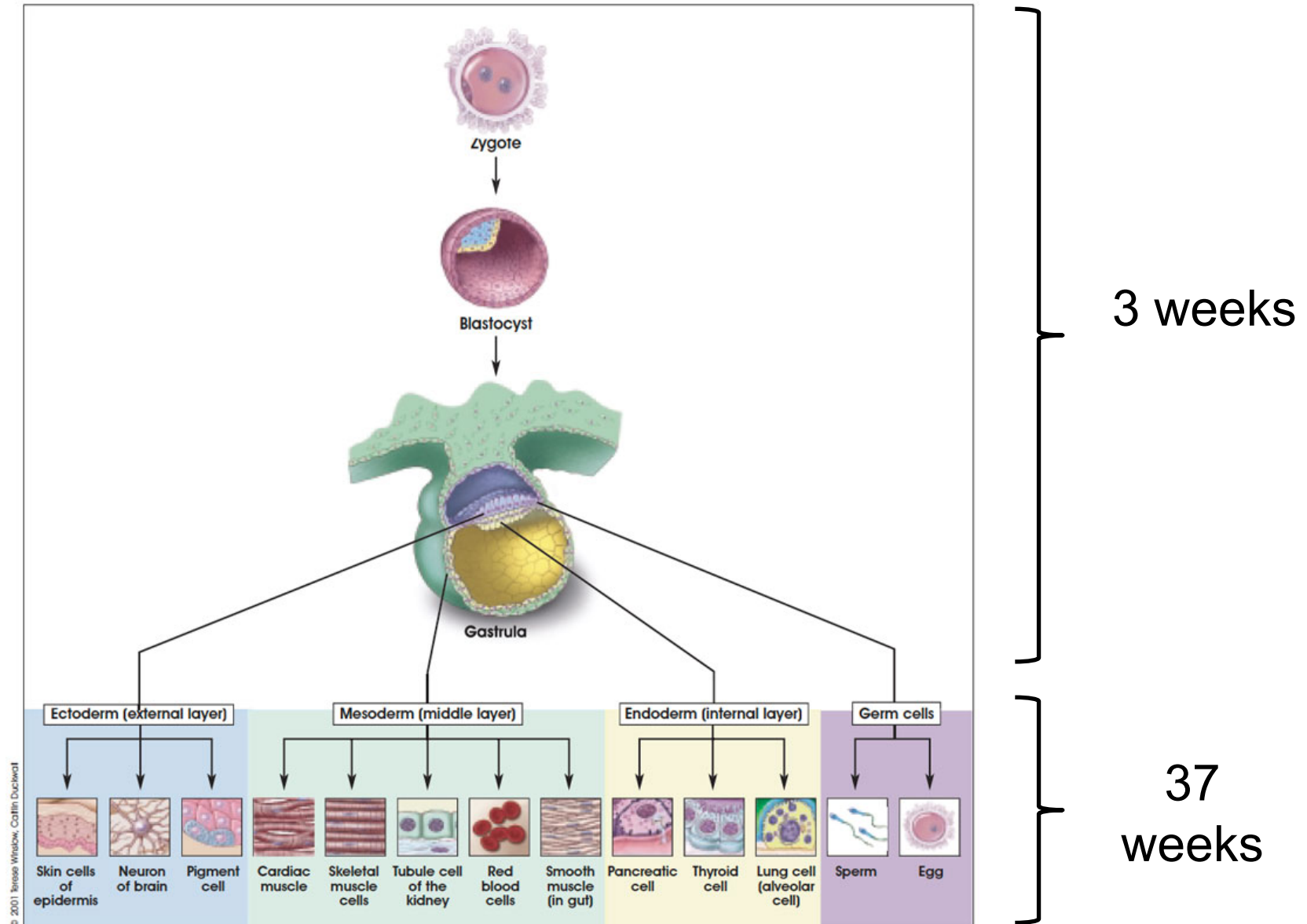
Mesoderm

musculo-skeletal system
limbs
connective tissue of skin and organs
urogenital system, heart, blood cells

Endoderm

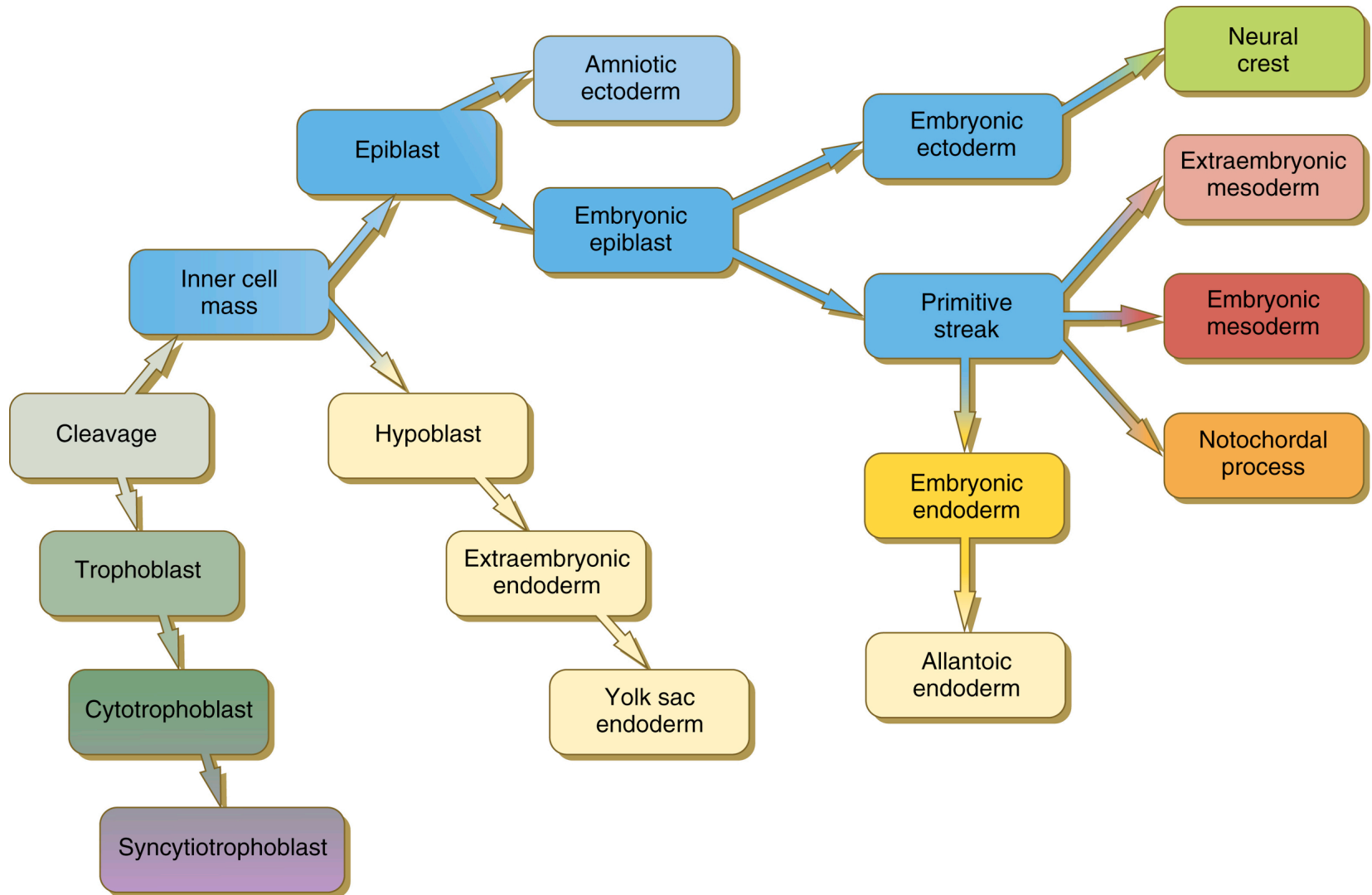
epithelial linings of gastrointestinal and respiratory tracts

Gastrulation:



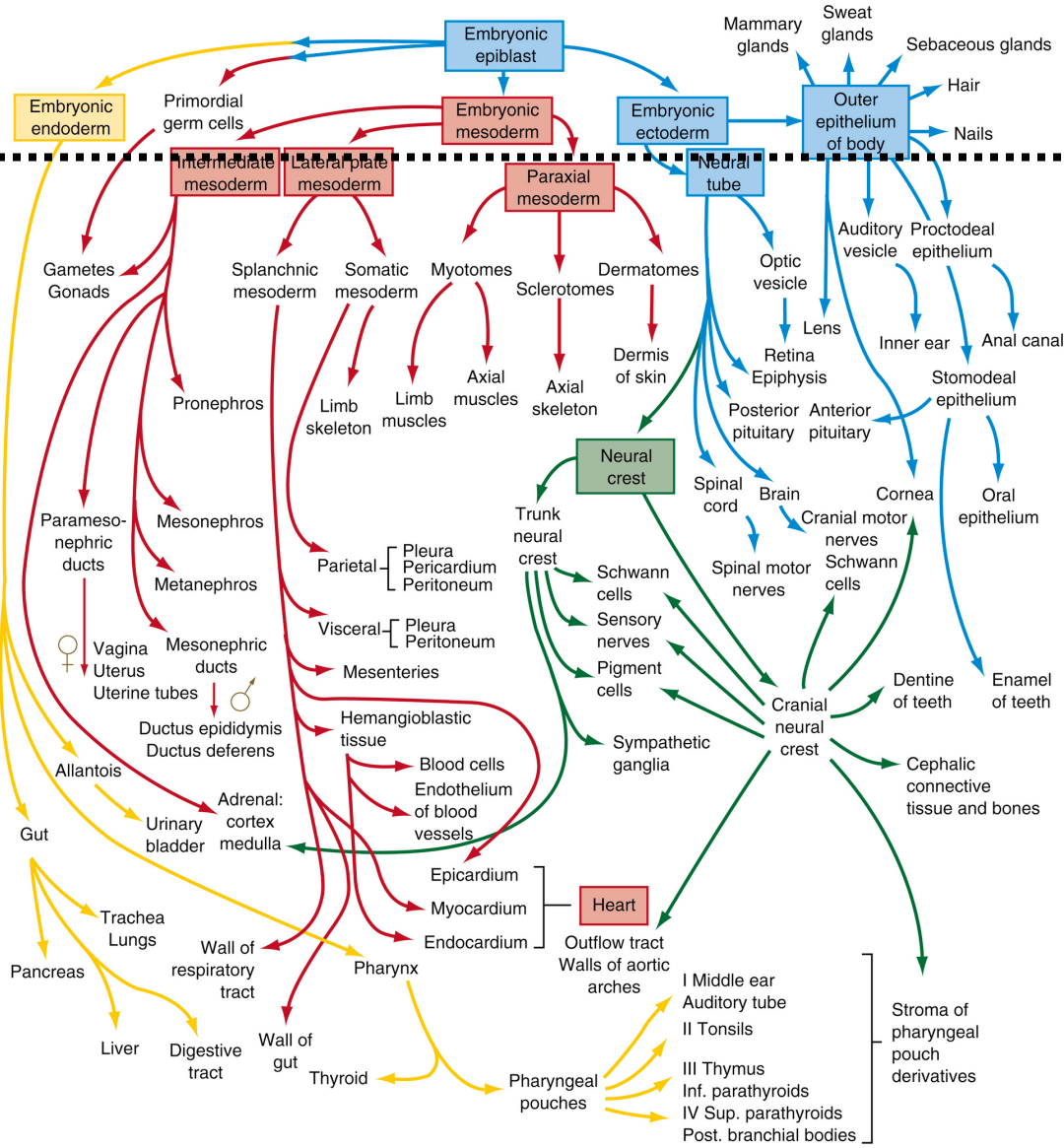
Gastrulation:

Cell lineages until gastrulation



Gastrulation

Cell lineages



Week 1 - 3

Systems Development

Week 3 Lecture overview

Placentation

Body axes

Gastrulation

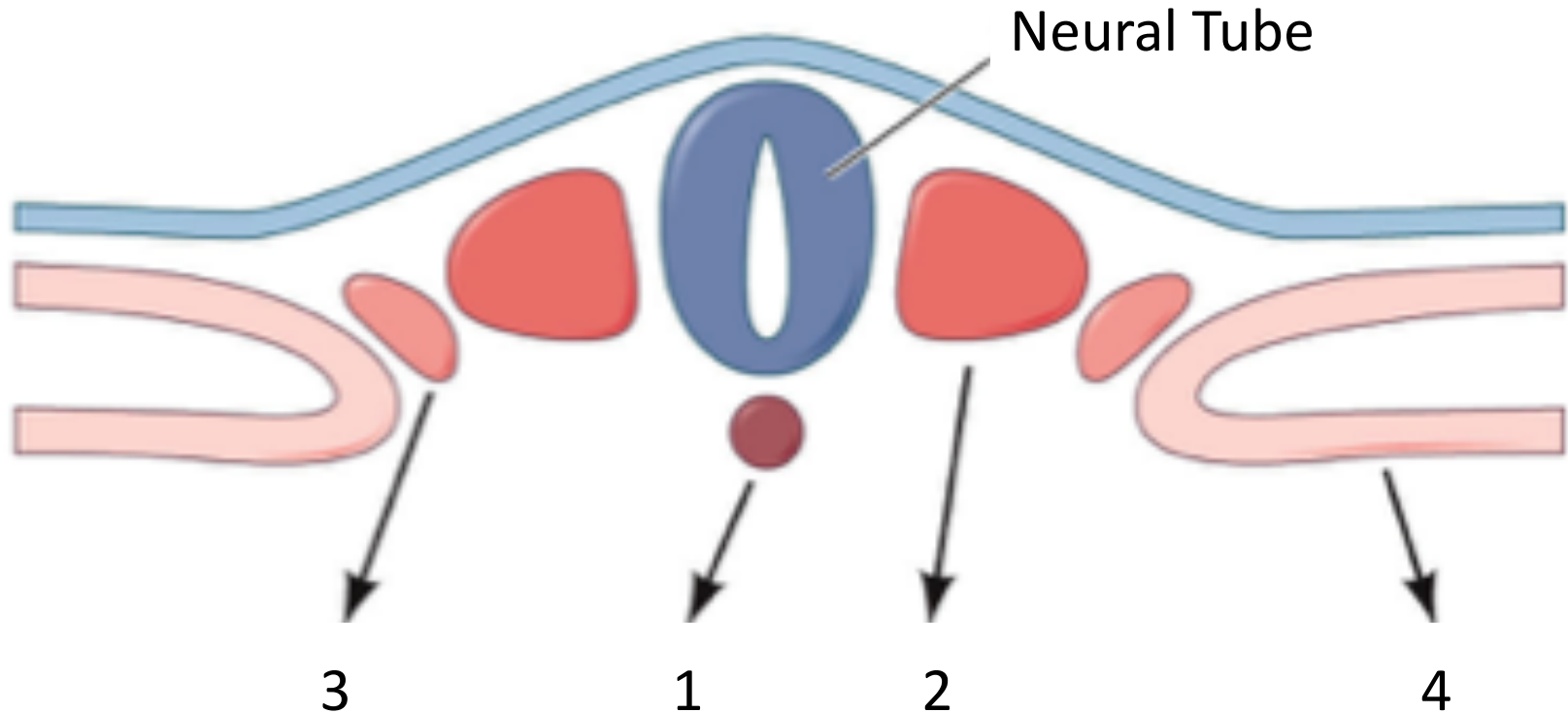
Axis formation

Embryo folding

Dr Annemiek Beverdam – School of Medical Sciences, UNSW
Wallace Wurth Building Room 234 – A.Beverdam@uq.edu.au

Embryonic folding

Mesoderm and Notochord



1: notochord

2: paraxial mesoderm

3: intermediate mesoderm

4: lateral plate mesoderm

Embryonic folding

Notochord

Axial mesoderm

Transient

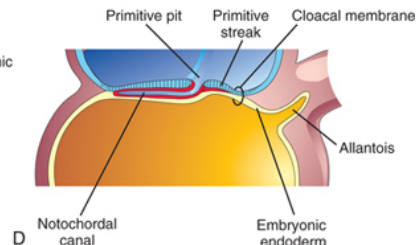
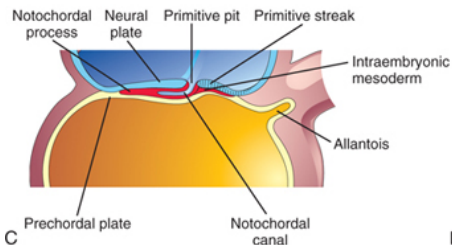
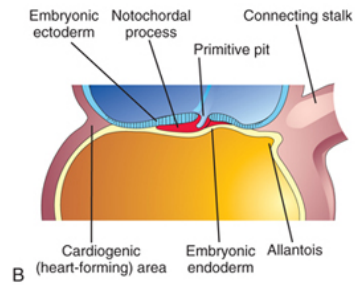
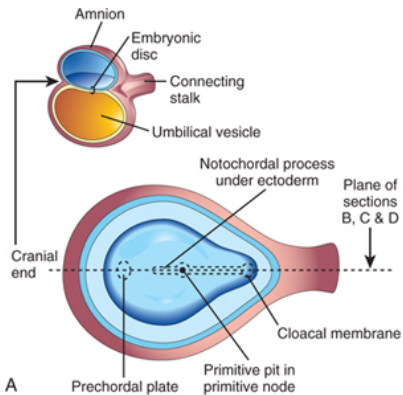
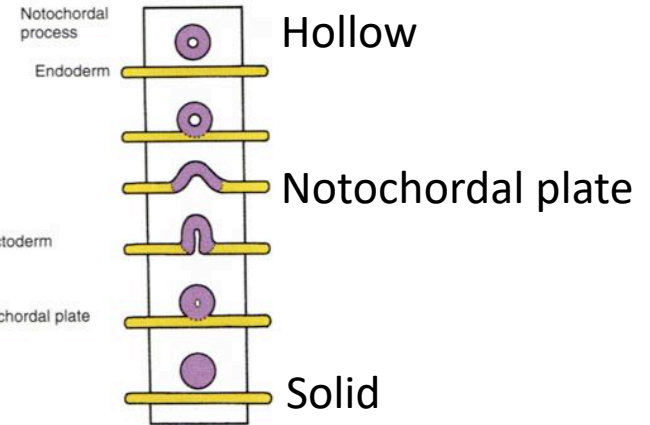
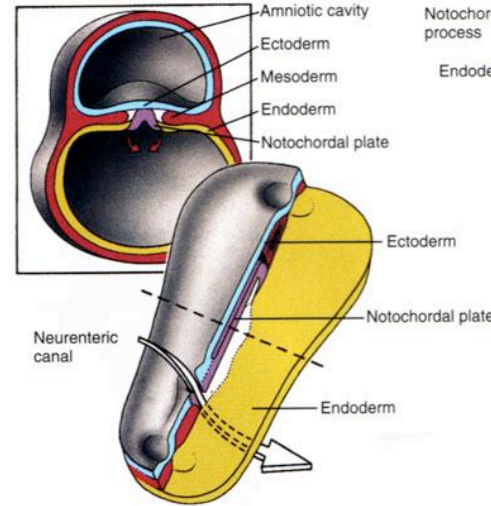
Development: notochordal process

Prechordal plate

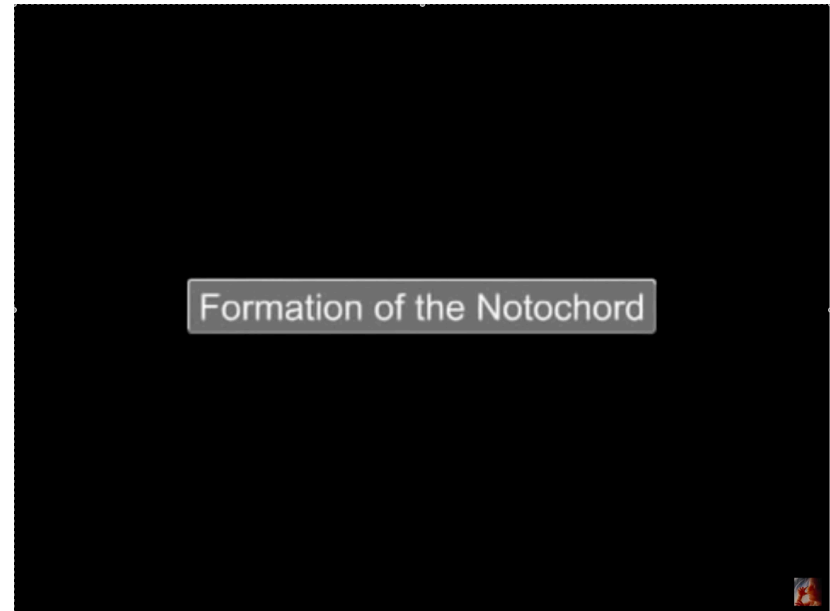
Neurenteric canal

Crucial signalling center

Mechanical role in embryonic folding



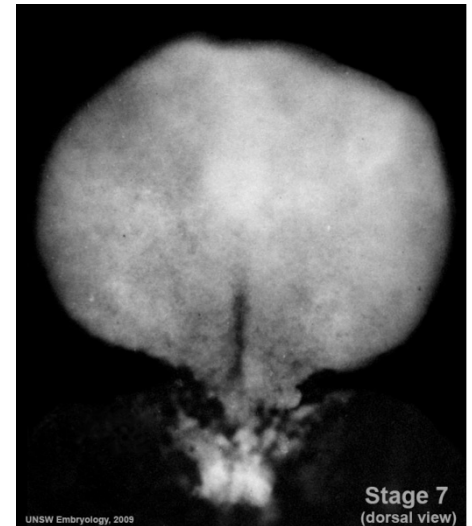
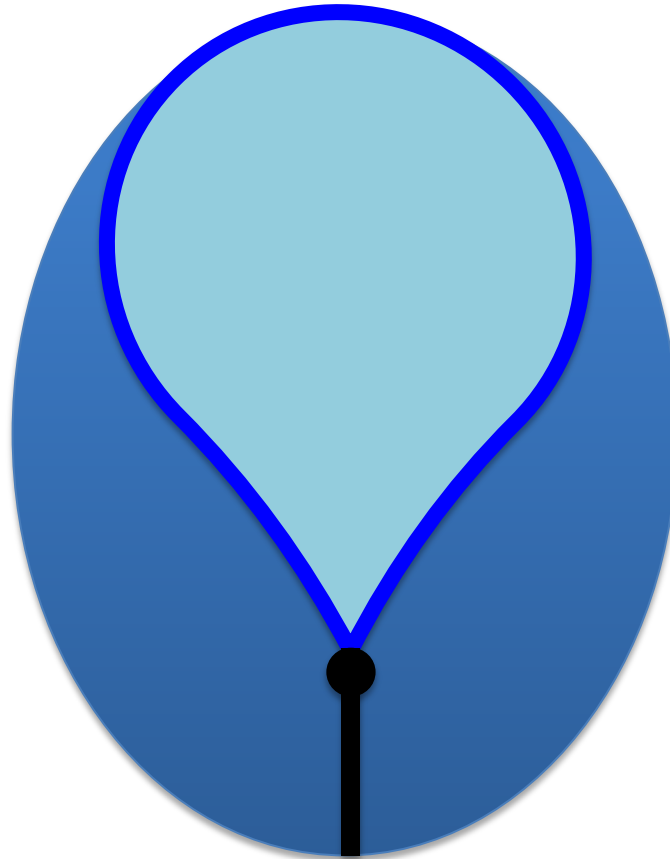
Moore et al: Before We Are Born, 8e
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Embryonic folding

Notochord signals to midplate ectoderm
neural plate formation
nervous system and neural crest

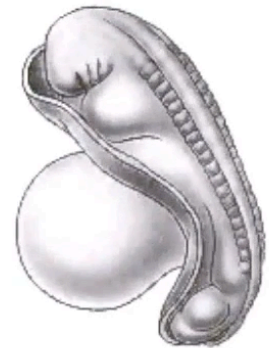
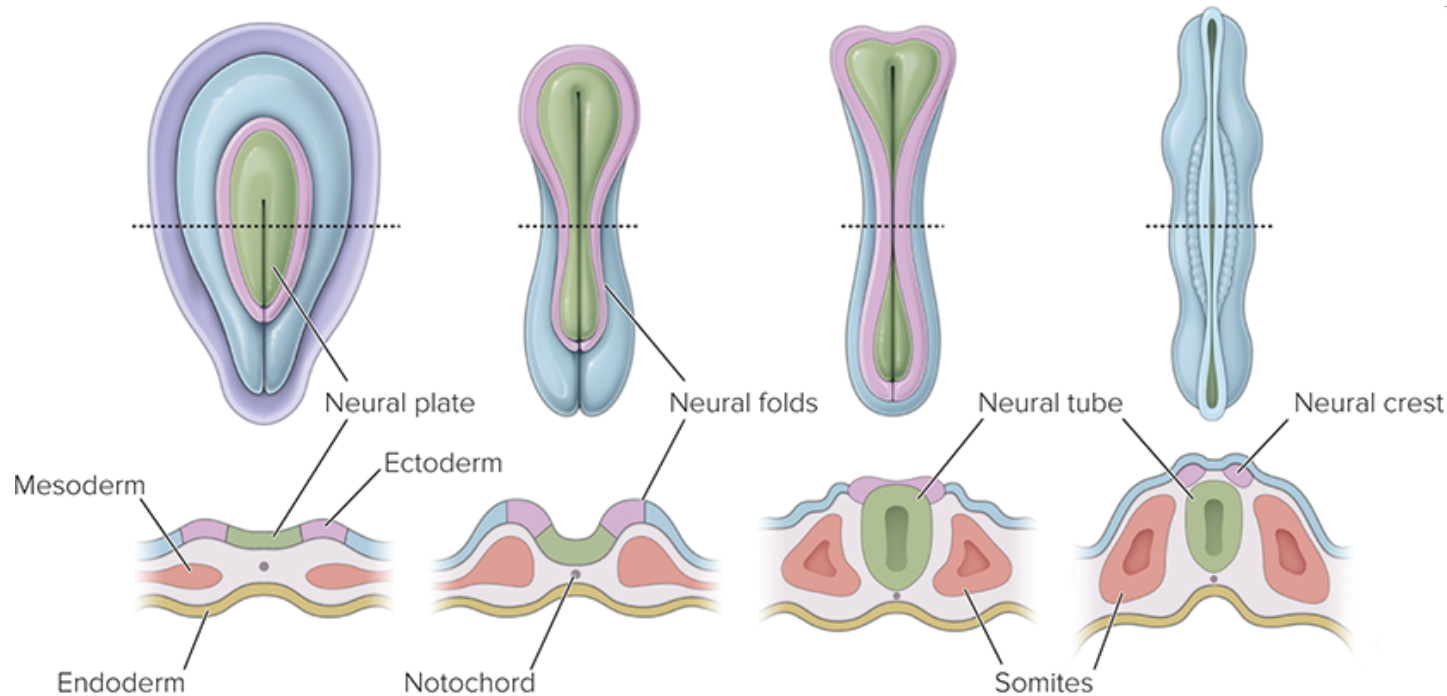
Lateral ectoderm: surface epidermis



Embryonic folding

Neurulation: 4 main events:

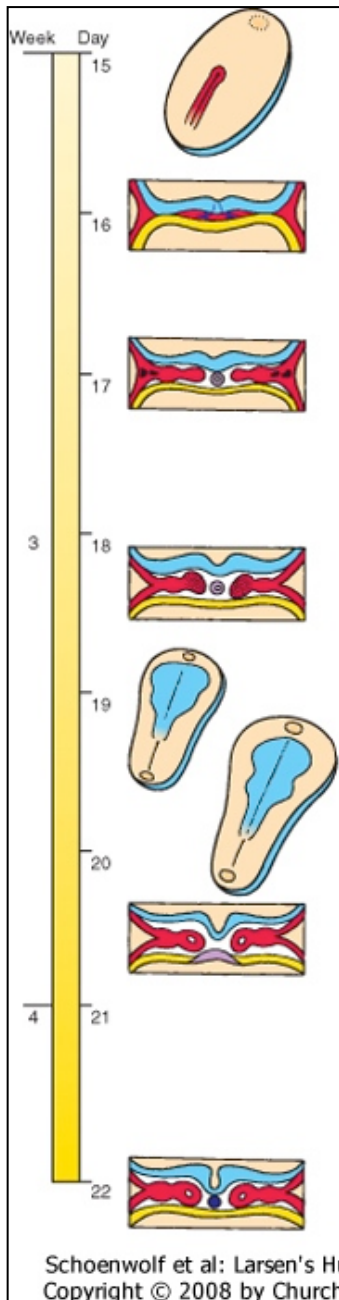
- 1 neural plate formation/neural induction
- 2 shaping of the neural plate
- 3 bending of the neural plate
- 4 closure of the neural groove



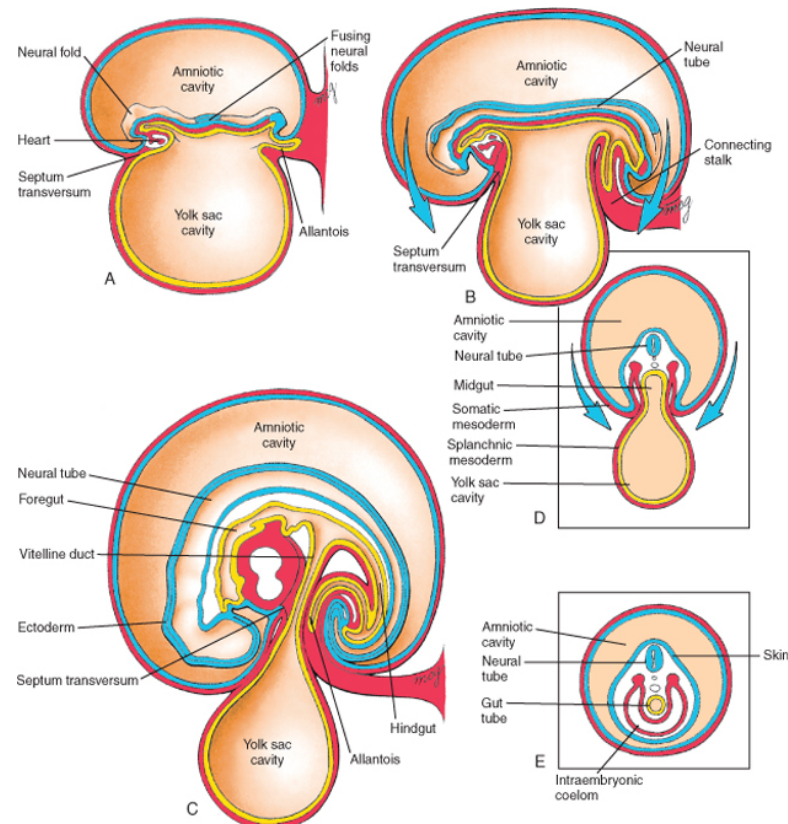
Embryonic folding

Around stiff notochord

Neural plate and neural tube from midplate ectoderm
 Generation of primitive gut from yolk sac endoderm



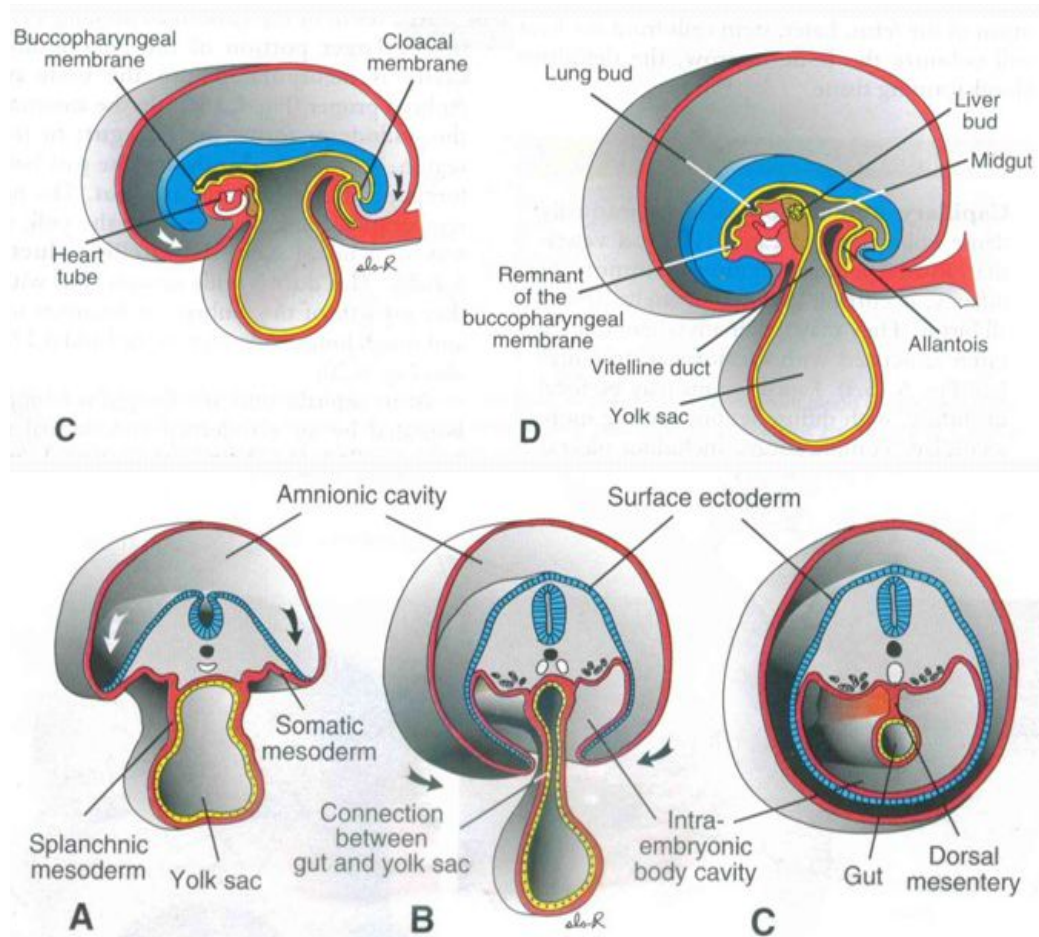
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Embryonic folding

Part of yolk sac is taken up into embryo to form primitive gut

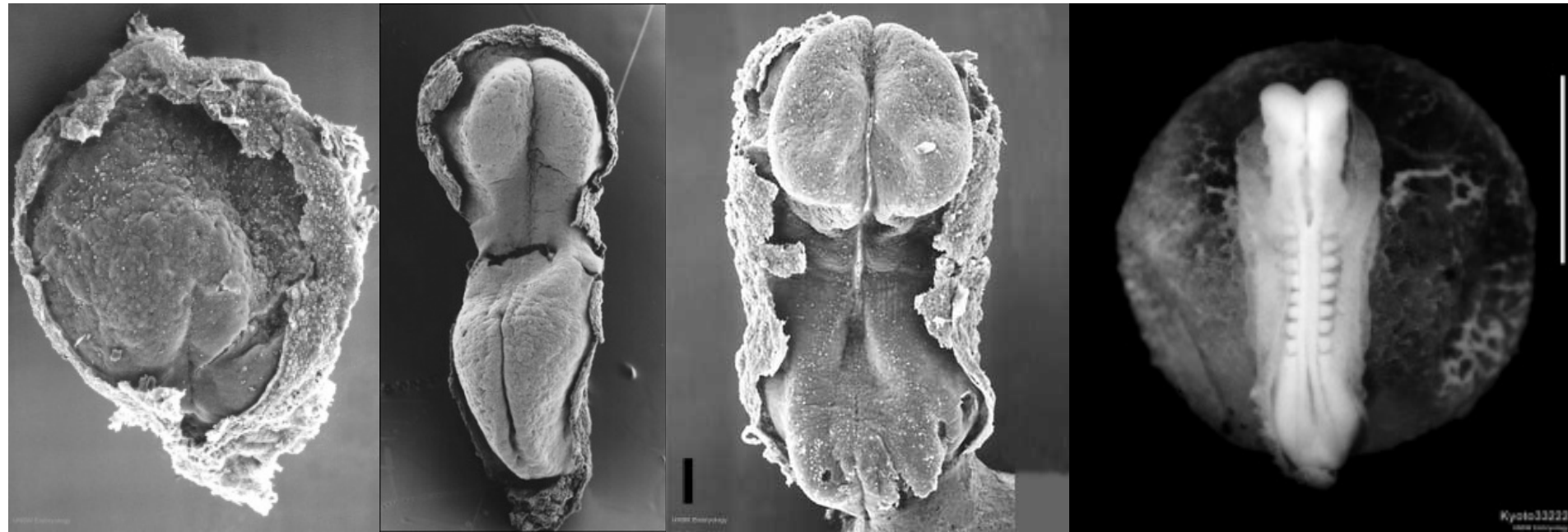


Embryonic folding



Embryonic folding

(Midplate) Ectoderm: Neural tube formation



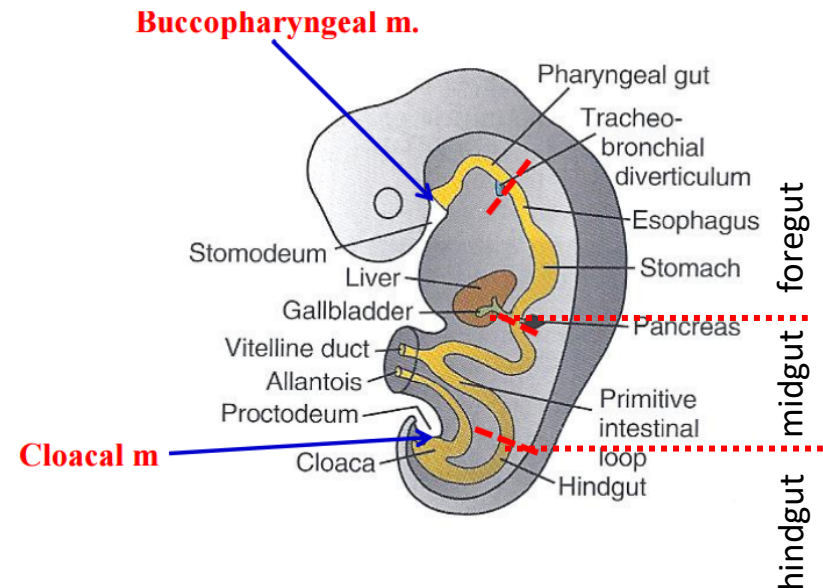
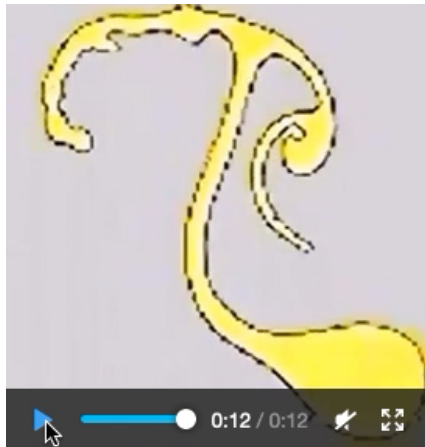
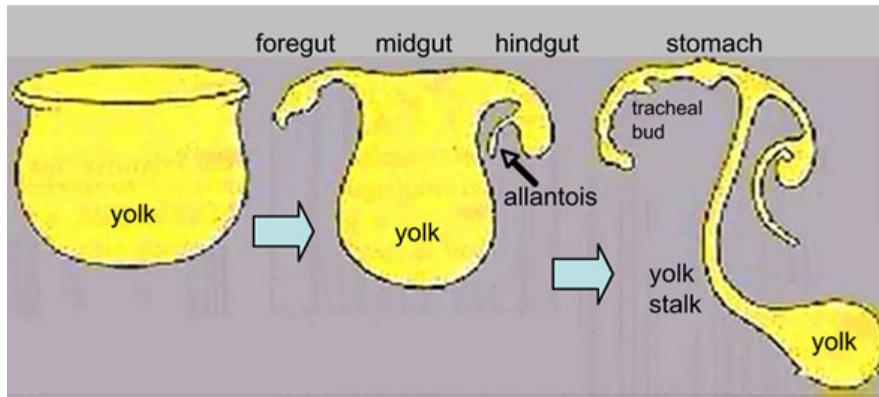
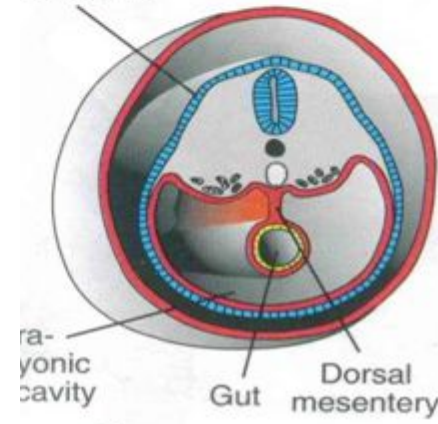
Embryonic folding

Endoderm: primitive gut formation

Primitive gut: foregut, midgut and hindgut

Oropharyngeal/buccopharyngeal membrane

Cloacal membrane



Week 3 Lecture overview

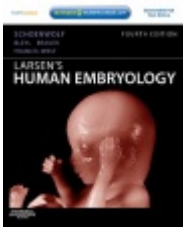
Placentation

Body axes

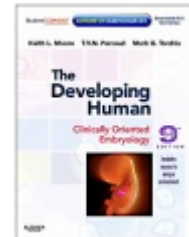
Gastrulation

Axis formation

Embryo folding



Resources:
<http://php.med.unsw.edu.au/embryology/>
Larsen's Human Embryology
The Developing Human: Clinically Oriented Embryology



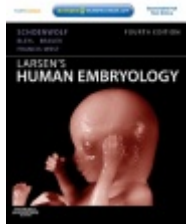
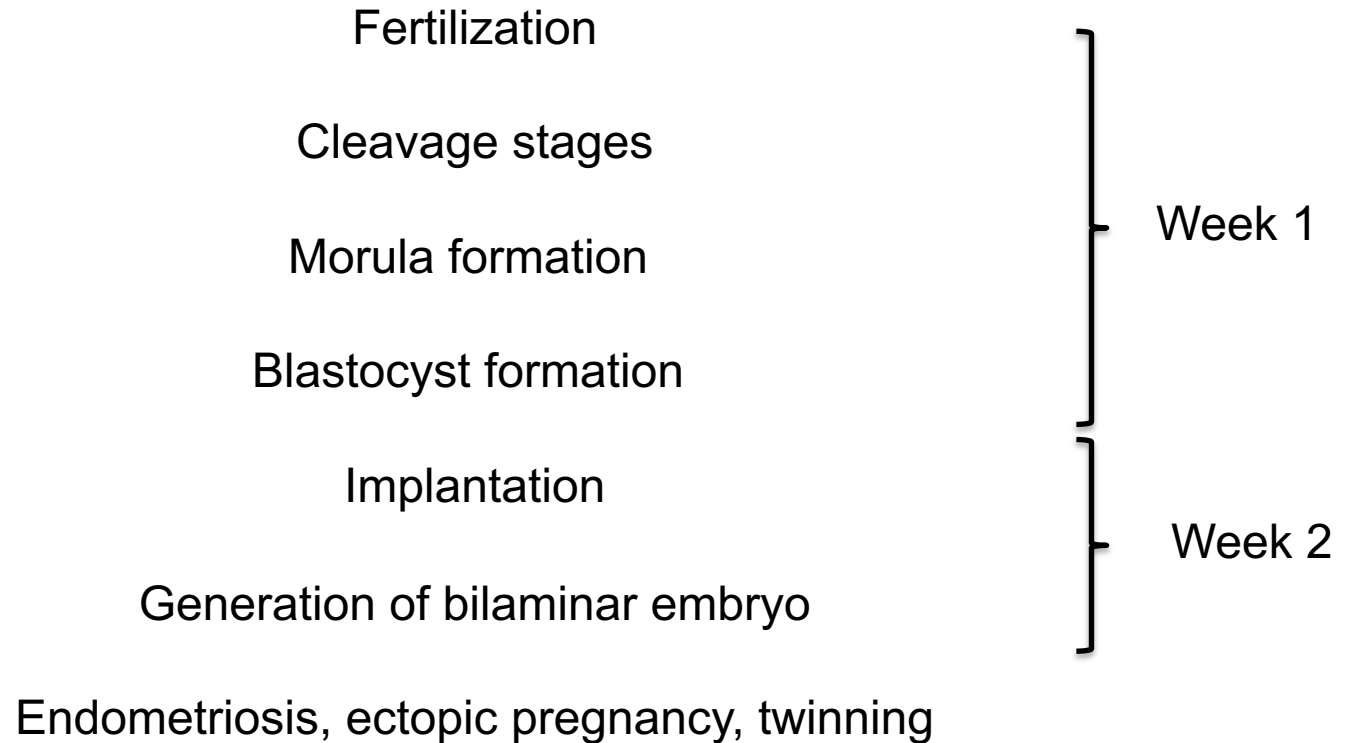
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Wallace Wurth Building Room 234 – A.Beverdam@unsw.edu.au

Labs Relevant to this Lecture

Gametogenesis, Fertilization, Preimplantion, Early Implantation, Gastrulation (Lab 1)

Gastrulation, early somitogenesis and neurulation lab – early chicken eggs (Lab 3)

Week 1/2 Lecture overview



Resources:
<http://php.med.unsw.edu.au/embryology/>
 Larsen's Human Embryology
 The Developing Human: Clinically Oriented Embryology

