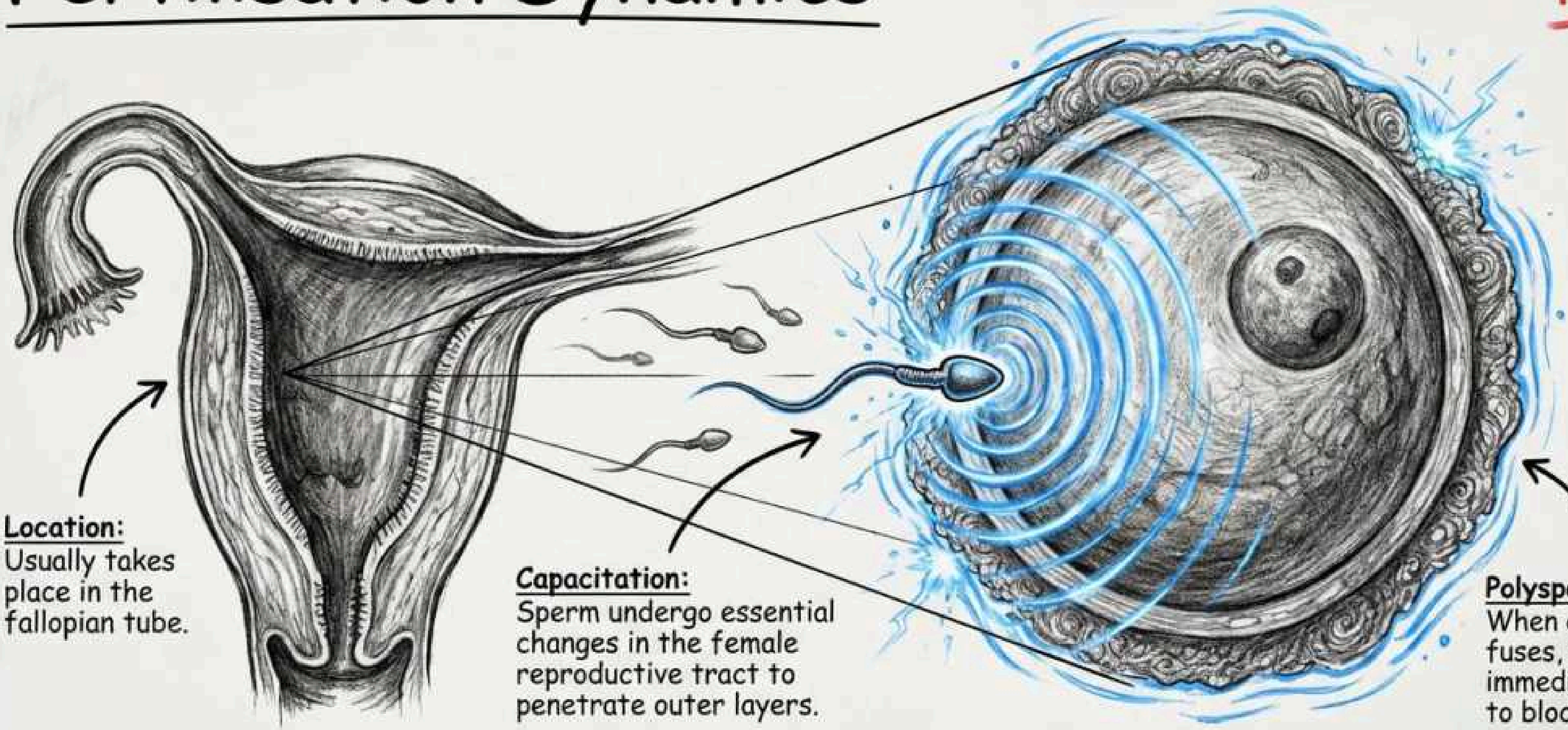
Fertilisation Dynamics

¶ 4.1



Location:
Usually takes place in the fallopian tube.

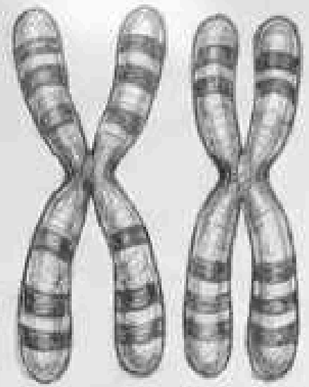
Capacitation:
Sperm undergo essential changes in the female reproductive tract to penetrate outer layers.

Polyspermy Block:
When one sperm fuses, the egg's coat immediately changes to block all others.

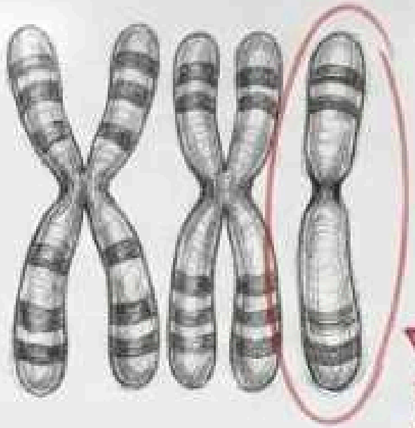
$$N_{sperm}\,(\text{released}) \approx 10^{6} \rightarrow N_{sperm}\,(\text{tube}) \approx 10^{2} \rightarrow \text{Fertilisation} = 1$$

The Zygote & Genetics

¶ 4.2



Normal Pair



Genetic Anomaly

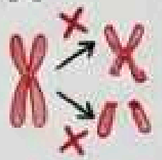
Trisomy
(Extra Chromosome)

23 maternal + 23 paternal = 46 chromosomes (Zygote)

Sex Determination: X_{egg} + [X_{sperm} = XX (Female) OR Y_{sperm} = XY (Male)]

Error Risk (Non-disjunction) ∝ Maternal Age

Errors in chromosome separation produce embryos with extra or missing chromosomes.

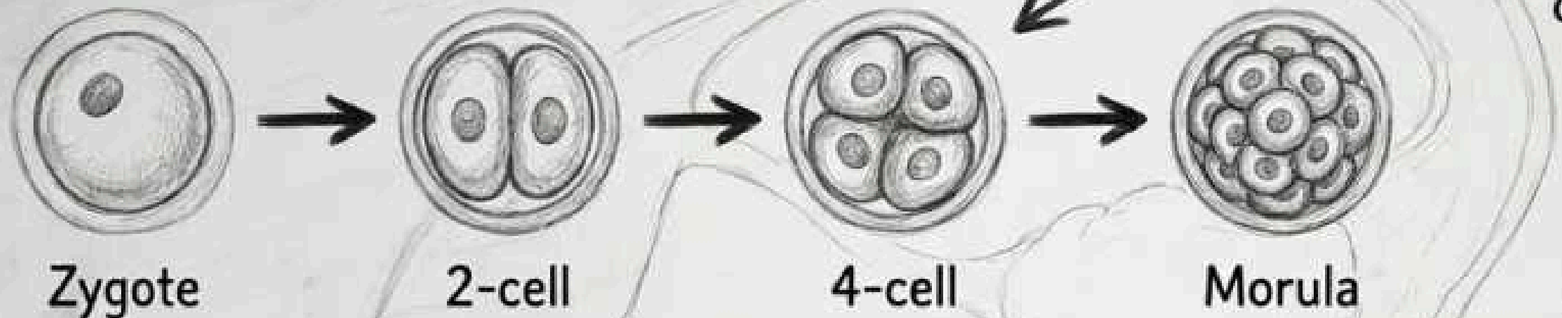


Clinical Outcome:
Leads to conditions such as Down syndrome.

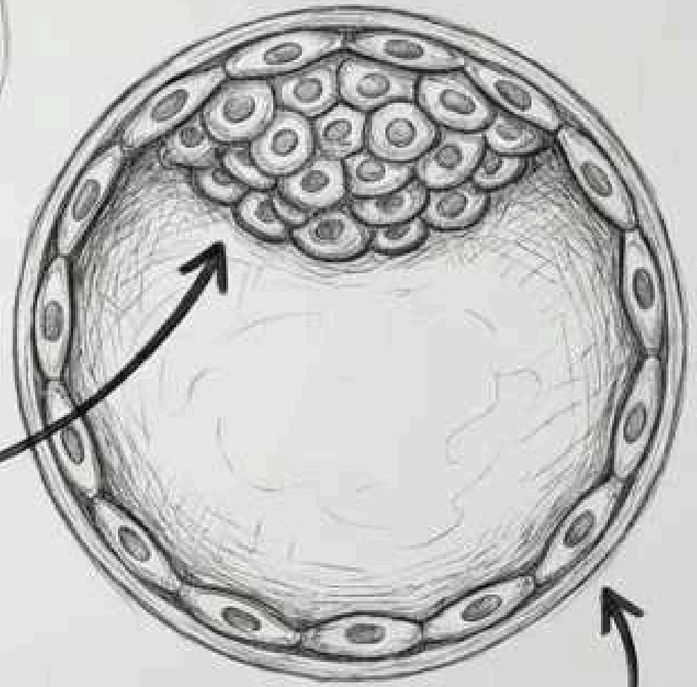
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Cleavage to Blastocyst (Days 1–5)

¶ 4.3



Repeated Division:
Occurs as the zygote travels down the fallopian tube.



Inner Cell Mass (ICM):
Will form the embryo.

Outer Layer (Trophoblast):
Will form much of the placenta.

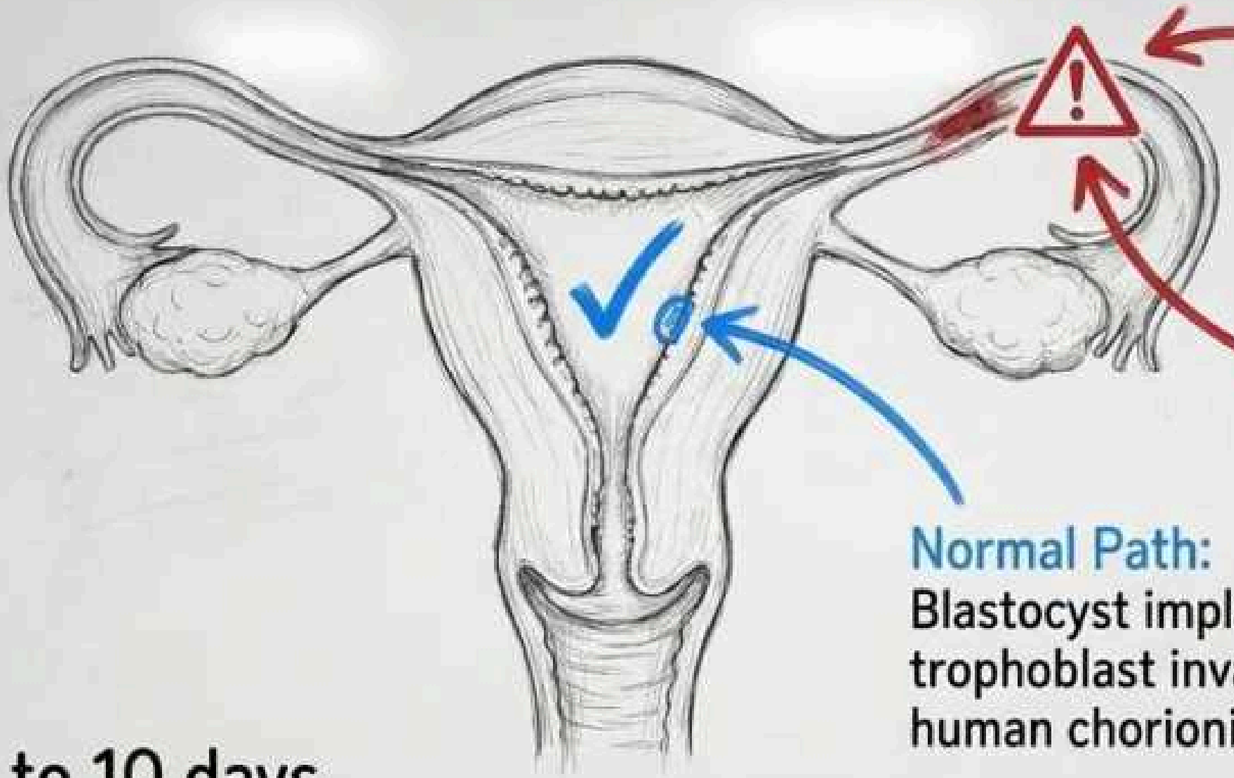
t = 0 to 5 days

Blastocyst (Hollow Ball) = ICM + Trophoblast

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Implantation & Ectopic Emergencies

¶ 4.4



Ectopic Pregnancy:
Implantation outside the uterus (most often in the tube).

Clinical Risk: As pregnancy grows, the tube can rupture and bleed severely.

Normal Path:
Blastocyst implants into endometrium; trophoblast invades lining and synthesizes human chorionic gonadotropin (hCG).

t = 6 to 10 days

If [Pregnancy Test (hCG)(+)] +
[Abdominal Pain OR Bleeding] → EMERGENCY: Rule out Ectopic Rupture

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The Statistics of Miscarriage

¶ 4.5

Unrecognized Losses: Many pregnancies end early, often before they are even recognized.

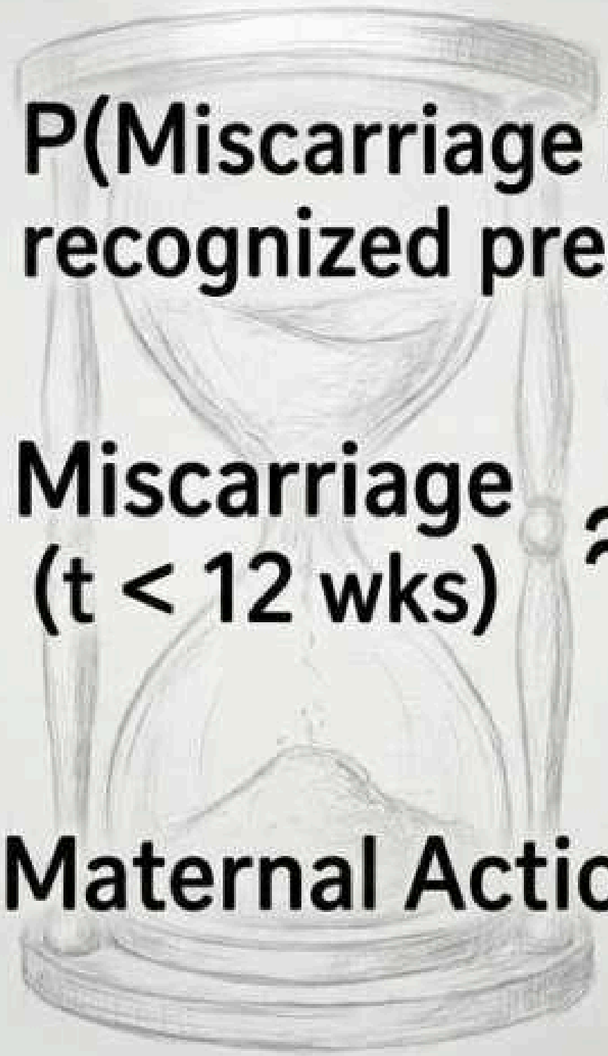
$$P(\text{Miscarriage in recognized pregnancy}) = \frac{1}{8}$$

Timing: The vast majority of recognized miscarriages occur in the first twelve weeks.

$$\text{Miscarriage } (t < 12 \text{ wks}) \approx 50\% \text{ due to chance chromosome errors}$$

Clinical Fact: Miscarriage is rarely caused by anything the mother did.

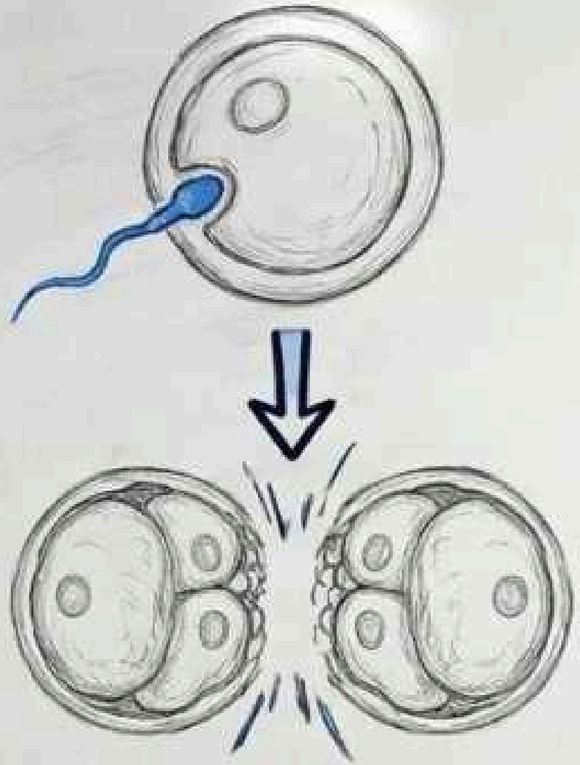
$$\text{Maternal Action} \neq \text{Cause}$$



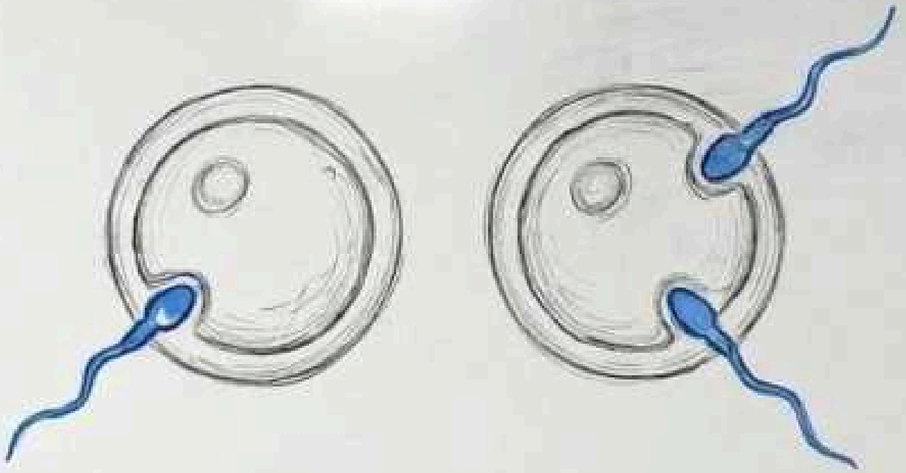
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The Pathways of Twinning

¶ 4.6



Monozygotic (Identical):
1 Ovum + 1 Sperm → Embryo Split
= 100% Genetic Match



Dizygotic (Fraternal):
2 Ova + 2 Sperm = Sibling
Baseline Match

Fraternal Variables: Runs in families. Probability ↑ with maternal age and fertility treatments.

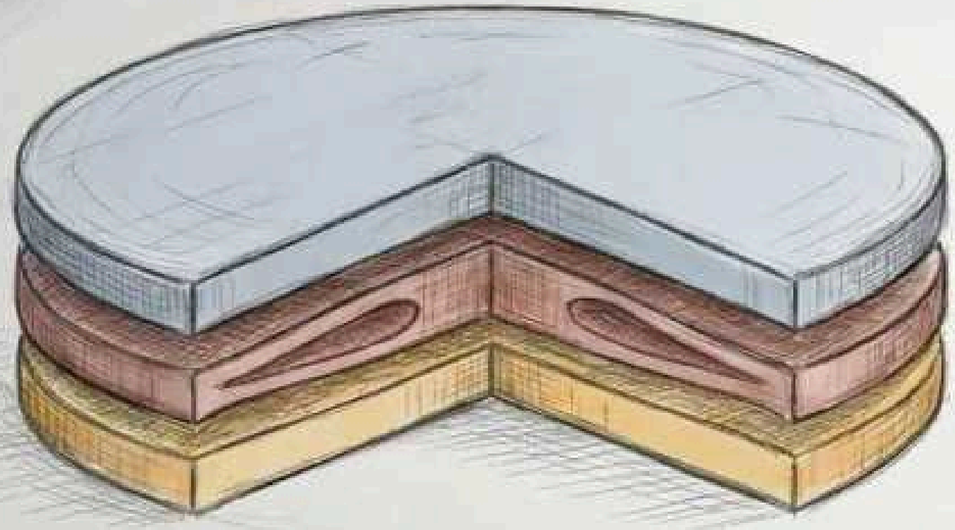
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Gastrulation and the Three Layers

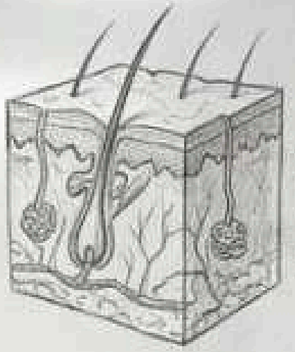
¶ 4.7

t = Week 3

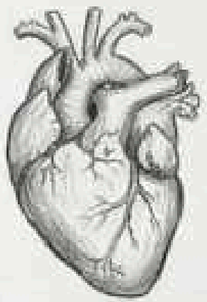
Embryo = $\sum$ (Ectoderm + Mesoderm + Endoderm)



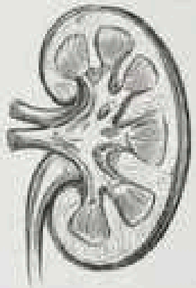




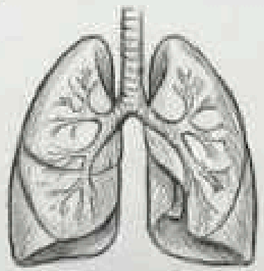
Outer (Ectoderm): Forms the skin and nervous system.

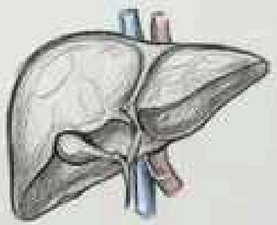






Middle (Mesoderm): Forms muscle, bone, the heart, blood vessels, and kidneys.





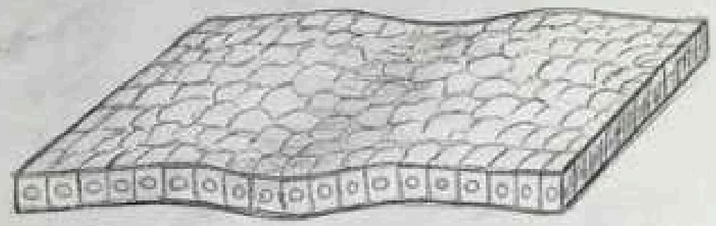
Inner (Endoderm): Forms the lining of the gut and lungs, plus organs like the liver and pancreas.

Trilaminar Mapping Diagram

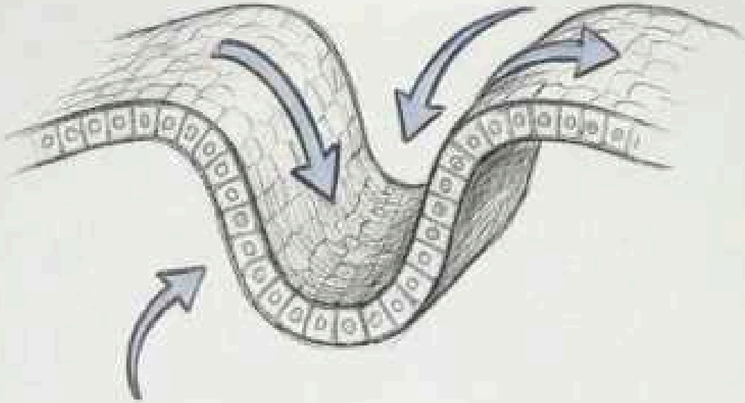
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Neural Tube Formation

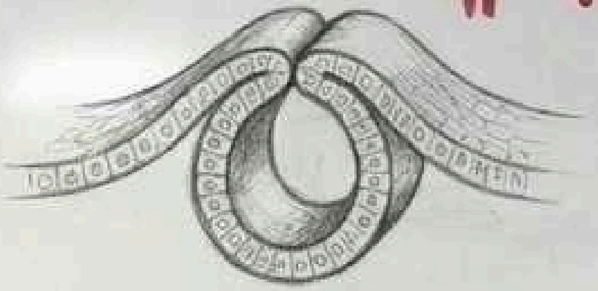
¶ 4.8



Flat Neural Plate



Folded Neural Groove



Fused Neural Tube



Closure Time ≈ End of Week 4
(often before pregnancy is known)

$$\text{Risk of NTD} \propto \frac{1}{\text{Pre-conception Folic Acid}}$$

Pathology: Failure to close results in a neural tube defect (NTD) such as spina bifida.

Public Health Intervention: Taking folic acid before conception and in early pregnancy greatly reduces risk. Many countries now add folic acid to flour.

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The Embryonic Period

¶4.9

t_{embryo} = Weeks 1 to 8

t > 8 Weeks → Fetal Period (Focus: Growth & Maturation)

Major Organogenesis: All major organs form in the first eight weeks.

Peak Vulnerability:
This window is the period of greatest sensitivity to harm from drugs, infections, radiation, and alcohol.

Cardiac Milestone:
The heart begins beating at around three weeks.



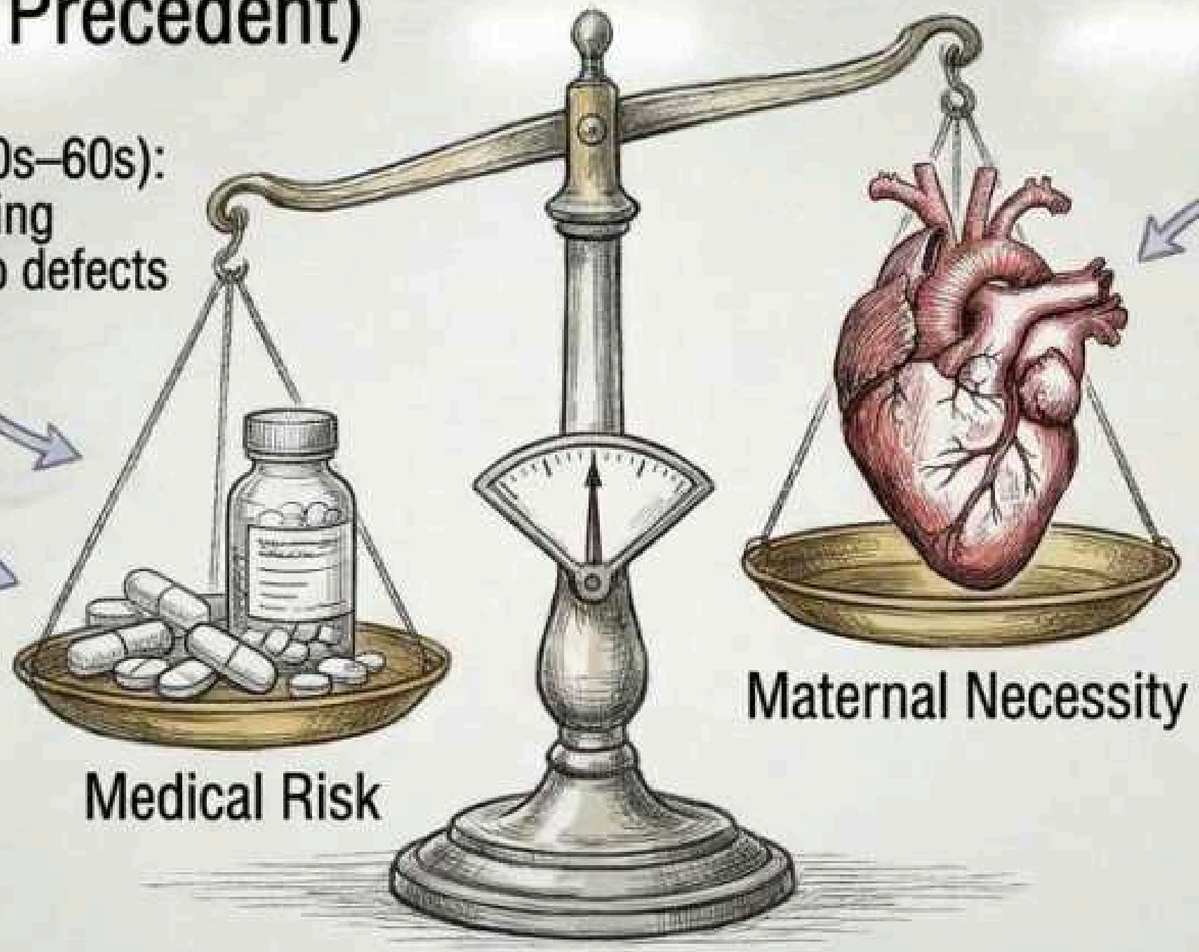
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Pharmacology in Pregnancy
(The Thalidomide Precedent)

¶ 4.10

Historical Context (Late 1950s–60s): Thalidomide, given for morning sickness, caused severe limb defects in thousands of babies.

Systemic Impact: Transformed worldwide drug regulation, mandating stricter testing and caution in pregnancy.



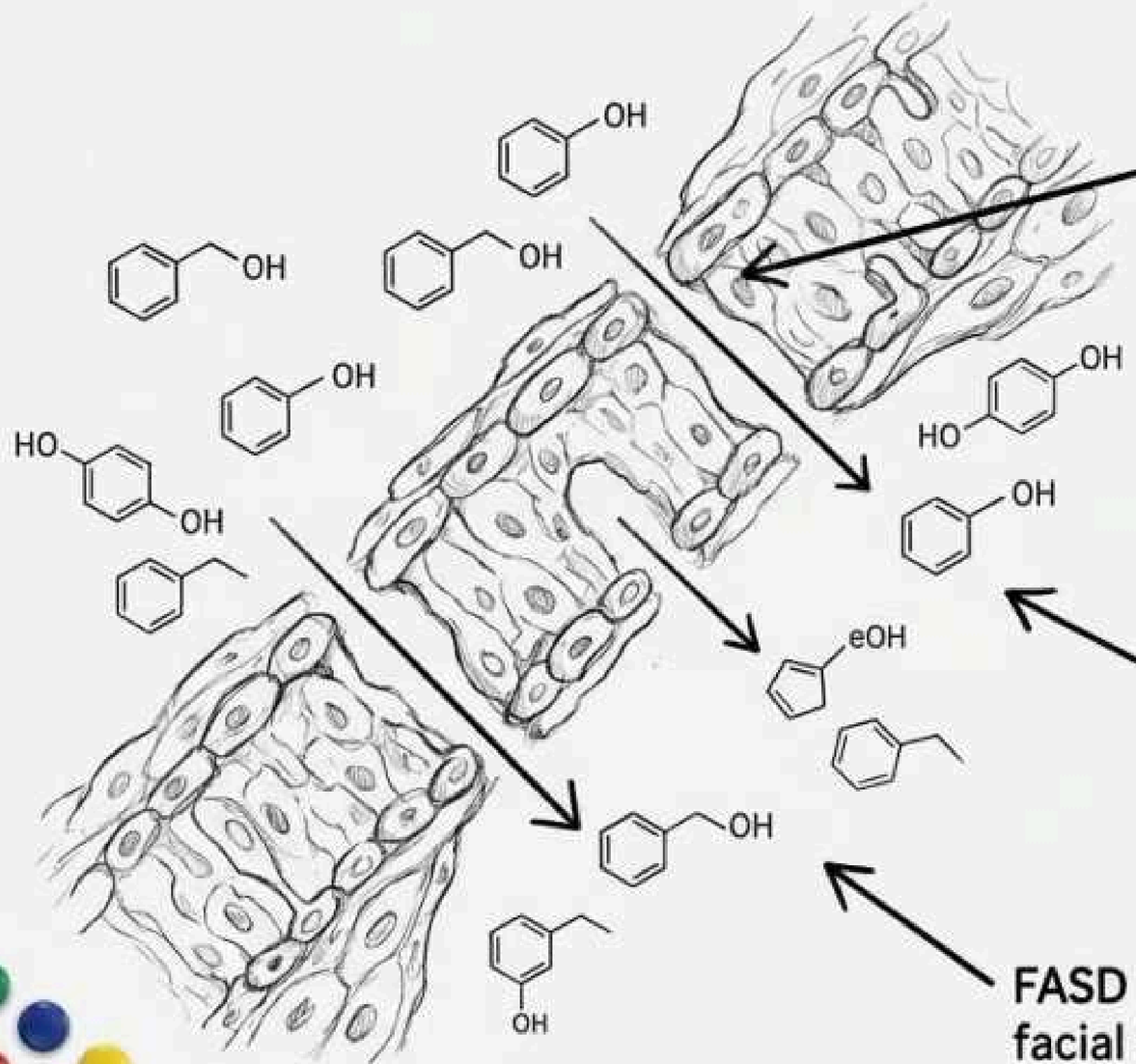
Modern Principle: Caution is mandatory, but withholding necessary treatment is dangerous—many conditions, untreated, harm both mother and baby.

Clinical Target: Benefit (Tx) > Risk (Fetus) + Risk (Untreated Mother)

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Fetal Alcohol Spectrum Disorder (FASD)

¶ 4.11



Mechanism: Alcohol crosses the placenta freely.

Safe Threshold Limit (EtOH) = Ø (Zero)

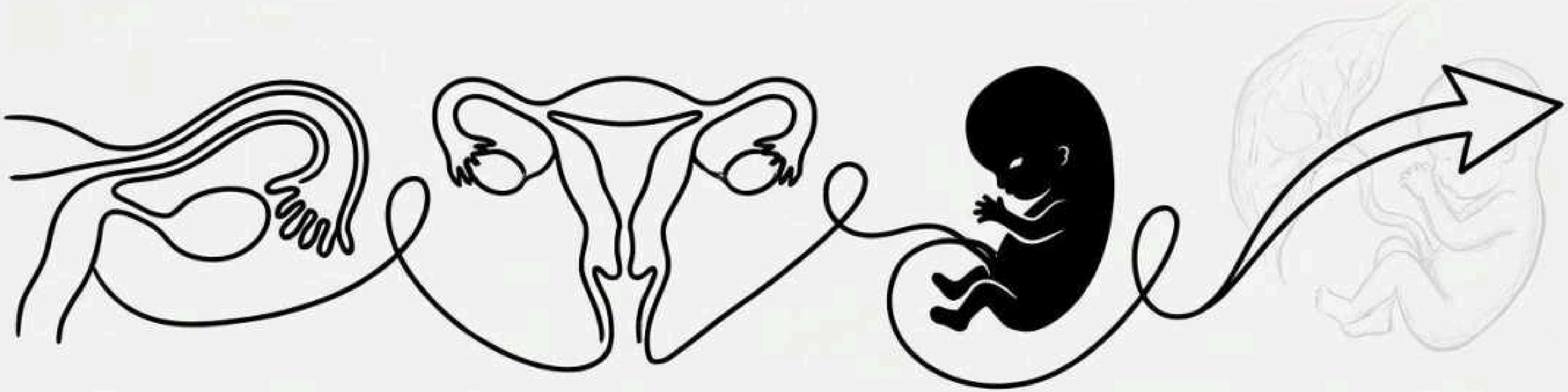
Guideline: Because no safe level has been established, health authorities advise complete avoidance during pregnancy and when trying to conceive.

FASD Impacts: Severe effects on fetal growth, facial features, learning, and behavior.

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Summary & Transition

¶ 4.12



Tube (Fertilisation) → Uterus (Implantation) → Wks 1-8 (Organogenesis, Max Vulnerability)

The Foundation: A new life begins with fertilization in the tube, implantation in the uterus, and rapid organ formation in the first eight vulnerable weeks.

Coming Up Next (Lecture 5): The focus will shift to the progression of pregnancy, the development of the placenta, and the mechanics of birth.

Gemini Notebook