Instant Anatomy

EMBRYOLOGY

IN A

NUTSHELL 1

DEVELOPMENT OF FETUS (40 WEEKS GESTATION)

- Embryonic period: 8 weeks
  - Formation of organs
  - Differentiation of tissues
  - Rapid body growth
- Fetal period: Rest of pregnancy
  (Maturation of organs)

Embryo needs:

1. To increase in size
2 To increase in complexity (specialisation of cells)
3 Longterm organisation with patterning (coding)

Mammalian Body Plan:

1 Bilateral symmetry
2 Body is double tube (a gut tube surrounded by coelom and hole at either end)
3 Multilayer body wall

Layers:

1 Ectoderm: Skin, sense organs, CNS
2 Mesoderm: Skeleton, CVS, muscles, etc
3 Endoderm: Gut, respiratory system

MITOSIS

"The production of two daughter cells genetically identical to the parent cell"

Each chromosome in the cell first replicates its DNA

This results in each chromosome consisting of 2 parallel chromatids, joined at a centromere. These double-structured chromosomes then line up on the equator and pull apart to each pole.

This results in each new cell having half the doubled chromosome material, i.e. the same as the original cell before division (diploid)

CHROMOSOMES

Each cell contains 46 chromosomes

22 pairs of "autosomes"
(similar but not identical in each sex)

1 pair of "sex chromosomes"
(XX in female and XY in male)

Sex is determined by the presence
of the SRY gene on the Y chromosome

The complete set of 46 chromosomes are
referred to as the Karyotype of the person

MEIOSIS

"2 cell-divisions by germ cells to produce gametes (sperm & oocytes) with haploid number of chromosomes (23)"

1. Each chromosome in the cell first replicates its DNA

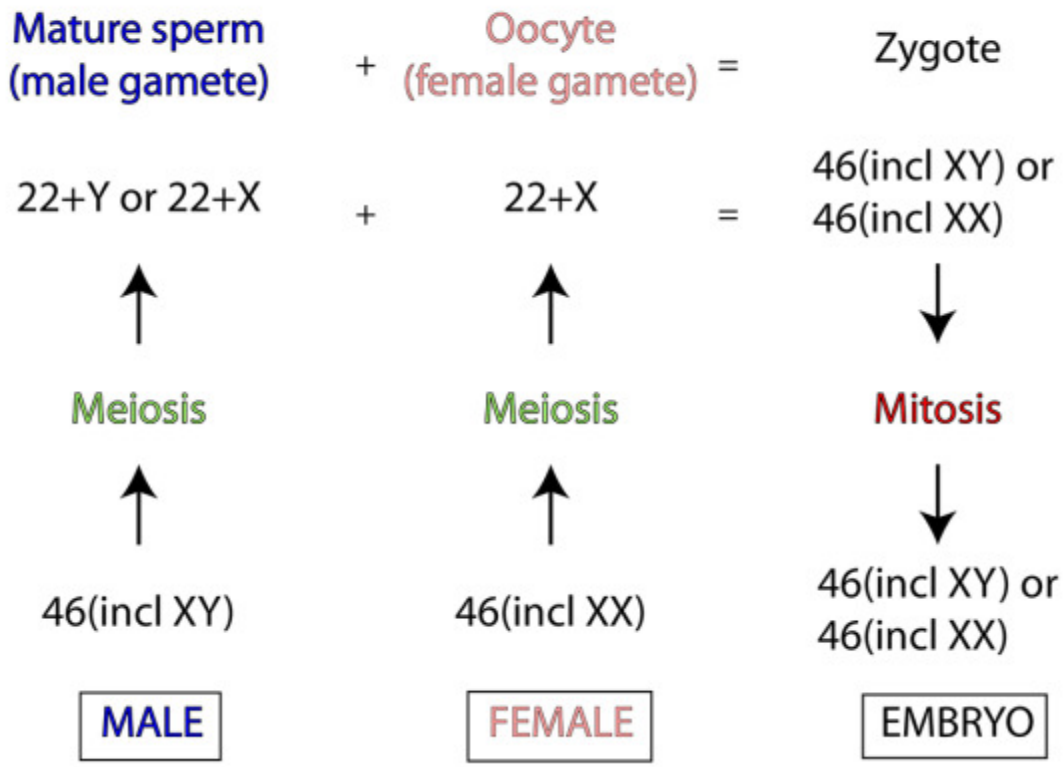
2. Each chromosome is then represented by 2 (sister) chromatids. The chromosomes then align in pairs

3. Points of contact (chiasma) allow cross-over (interchange) of chromatid segments, some 30-40 in total (1-2 per chromosome) to give genetic variability

4. A second meiotic division separates sister chromatids to give gametes with 23 chromosomes each (haploid)

Day 1

FERTILISATION



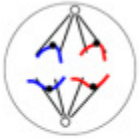
WHAT IS A CHROMATID?

One half of a replicated chromosome that is bound to its other sister chromatid by the centromere during cell division; each of these parallel components is destined to become one chromosome in the daughter cell after they have been pulled apart by the mitotic spindle.

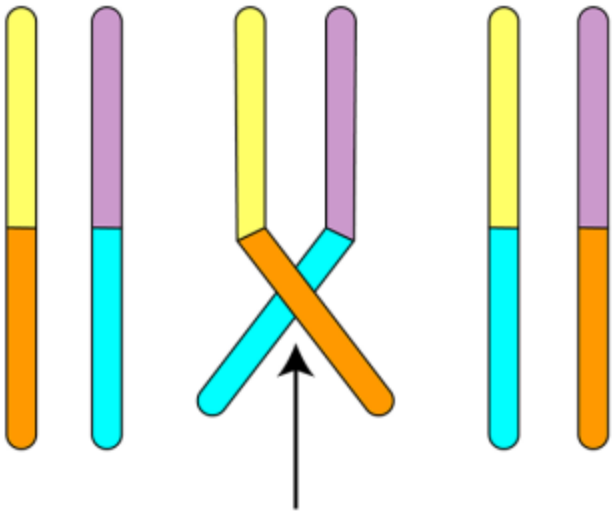
Or simply

One half of a replicated chromosome only seen in meiosis or mitosis

MITOSIS → 2 daughter cells
(showing a single pair of chromosomes)

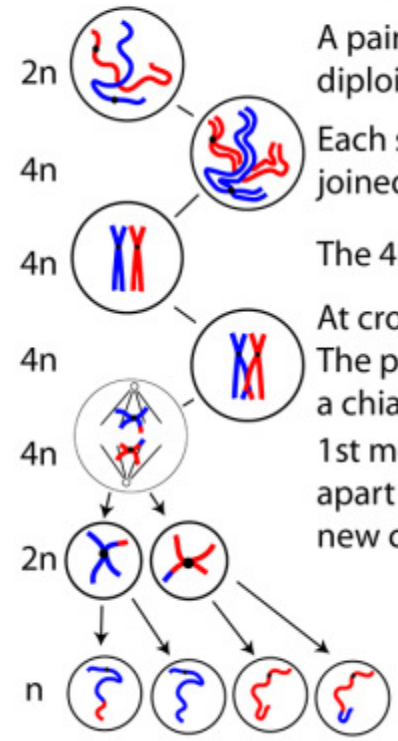
Cell content of DNA		
Diploid 2n (normal)		A pair of chromosomes in a cell nucleus. Each is a strand (double helix) of DNA
Diploid 4n (double)		Each strand replicates to give 2 chromatids joined at a centromere
Diploid 4n (double)		During metaphase the 4 chromatids line up at the equator having contracted and condensed
Diploid 4n (double)		Centromeres divide and pull the chromatids apart and they each become a chromosome
Diploid 2n (normal)		Nuclear envelope reforms as two separate daughter cells

Interchange of chromatid segments at **CROSS OVER** to give genetic variation



Points of interchange temporarily united at chiasma

MEIOSIS → 4 Gametes
(showing a single pair of chromosomes)



A pair of chromosomes in a germ cell nucleus which is diploid. Each is a strand (double helix) of DNA

Each strand replicates to give 2 chromatids joined at a centromere

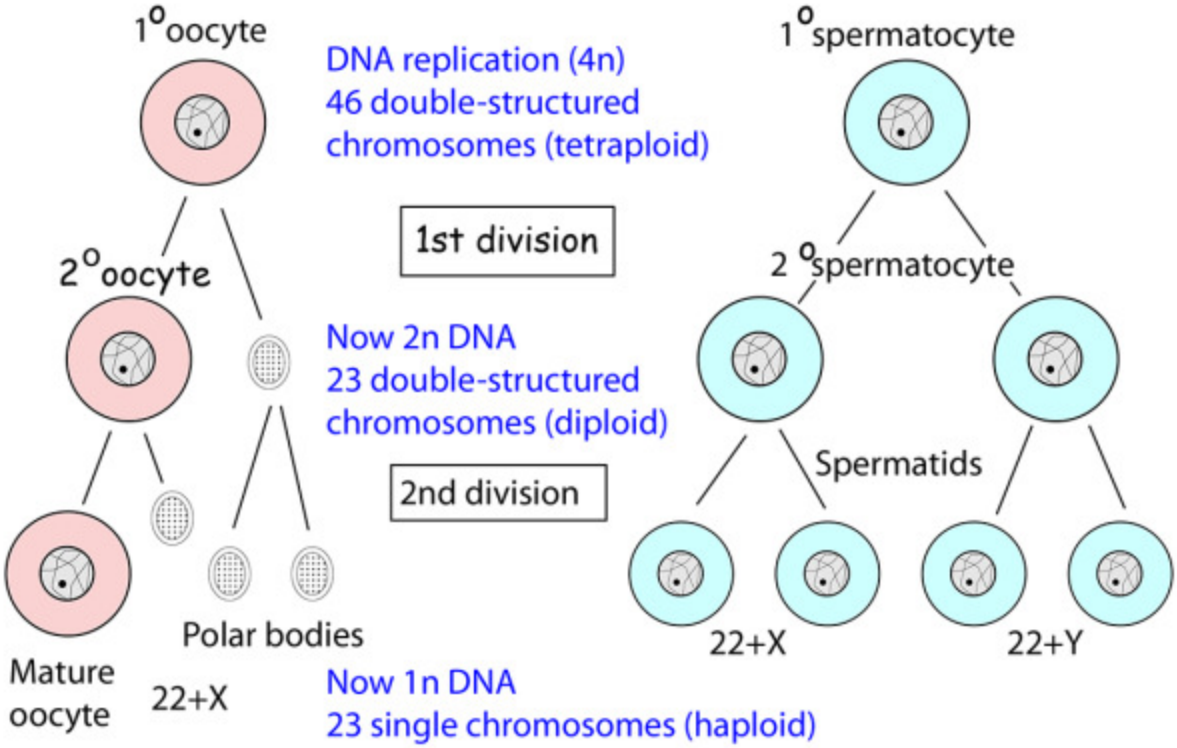
The 4 chromatids line up having contracted and condensed

At crossover there is interchange of chromatid segments. The points of interchange are temporarily united to give a chiasma (X-like structure)

1st meiotic division, the two lots of chromatids pull apart and the nuclear envelope reforms around two new cells which are diploid

In the 2nd meiotic division the chromatids split at the centromeres and give 4 daughter cells that are different from each other but are all haploid

MEIOTIC DIVISIONS



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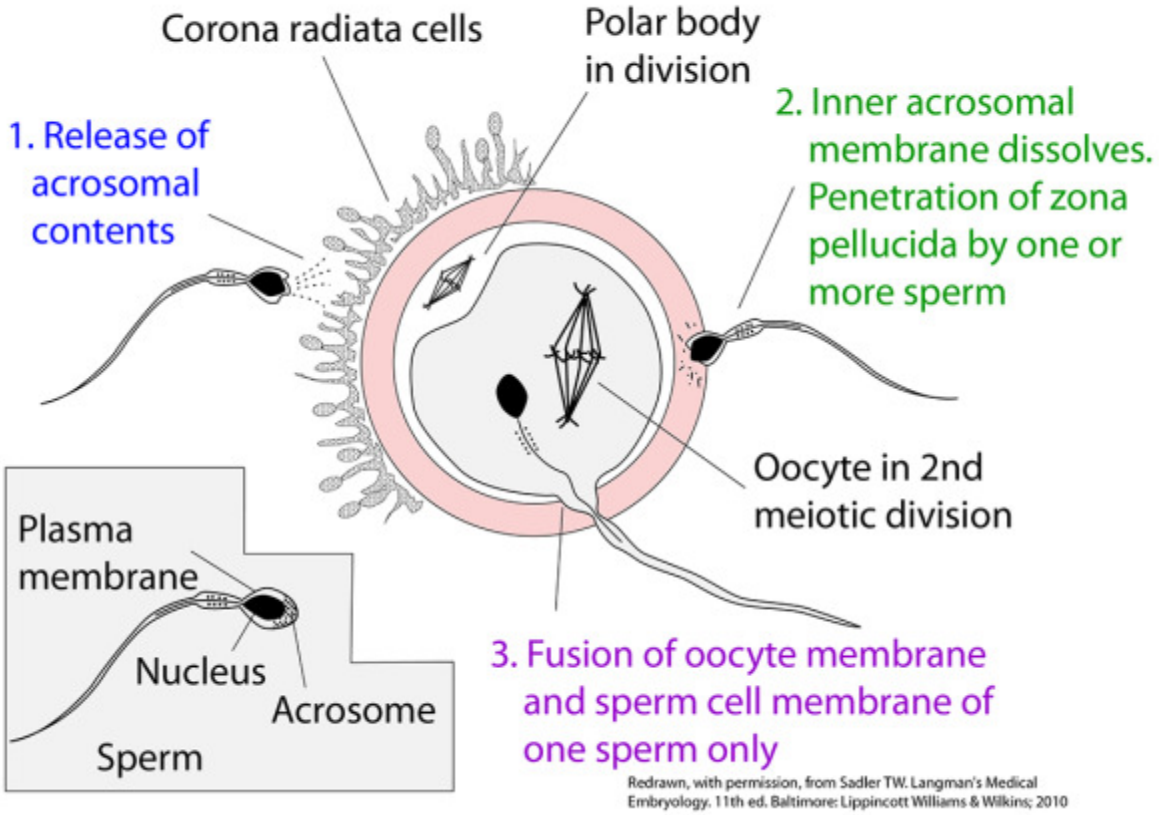
FERTILISATION IN AMPULLA OF FALLOPIAN TUBE



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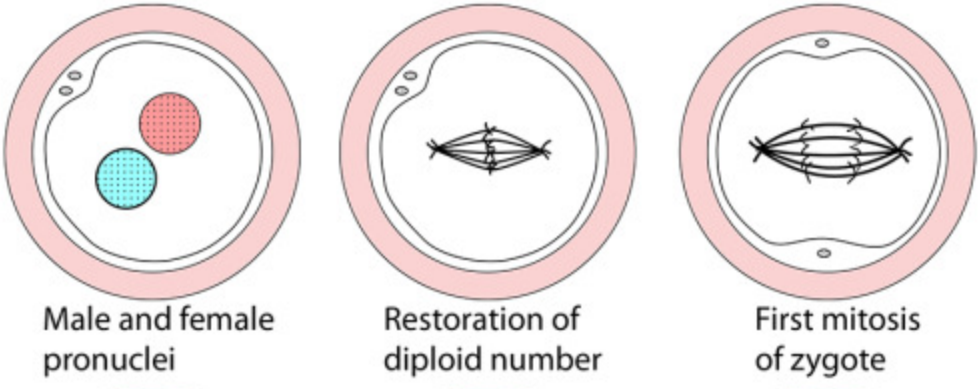
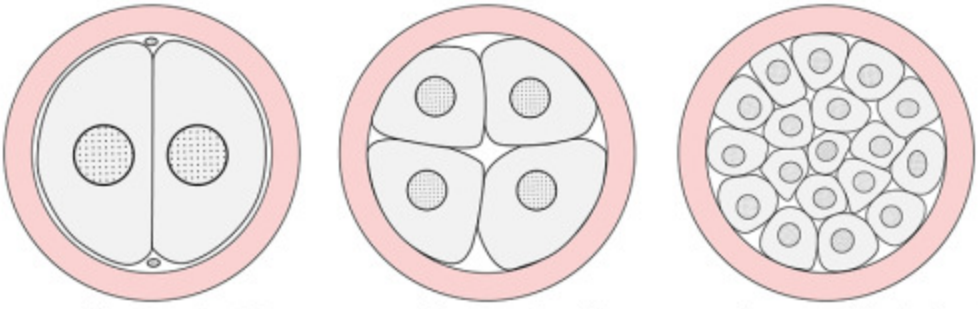
CLEAVAGE GIVING EMBRYONIC CELLS (BLASTOMERES) WITH INCREASING NUMBER OF SMALLER CELLS



Male and female pronuclei | Restoration of diploid number | First mitosis of zygote



2 cell stage (30h) | 4 cell stage (40h) | Morula: 16 cells (3 days)

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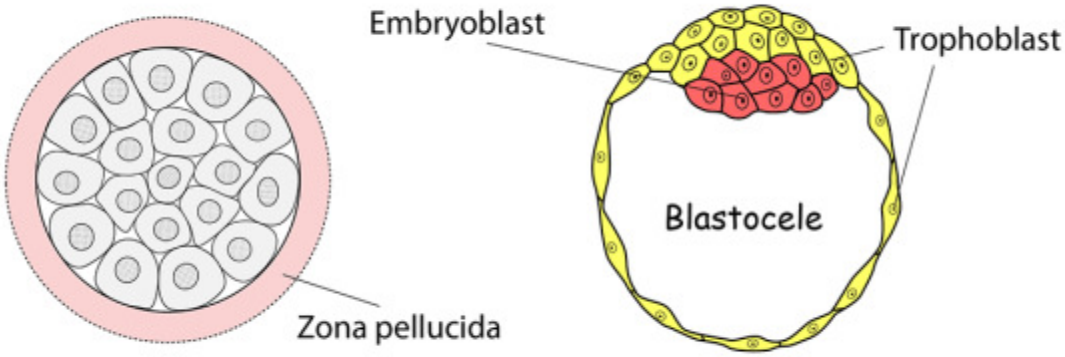
BLASTOCYST FORMATION



Morula (finally 128 cells) enters uterus at 4 days and, as the zona pellucida disappears, fluid enters the intercellular spaces and becomes a single cavity - blastocele. The embryo is now a blastocyst

The inner cell mass is pushed to one end to give the embryoblast and the outer cells become the trophoblast. They surround the blastocele cavity. Loss of the zona pellucida allows implantation

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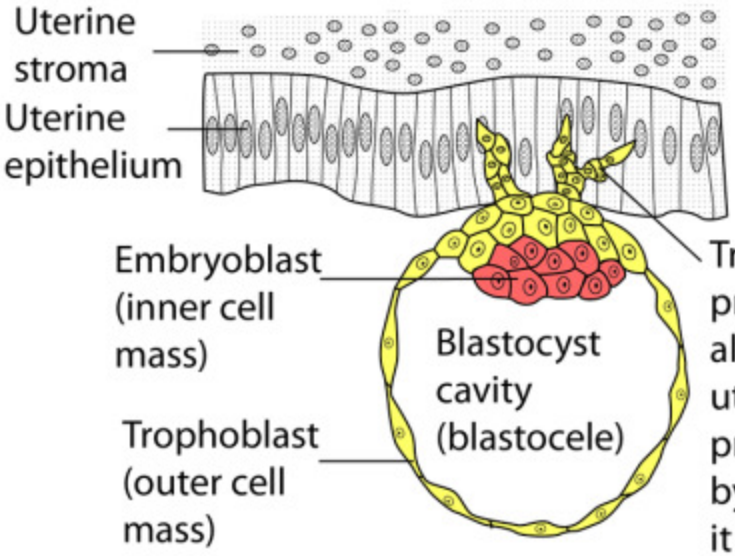
EARLY (6th DAY) IMPLANTATION OF BLASTOCYST



Trophoblast cells produce proteolytic enzymes that allow early invasion into uterine wall. There is promotion of this action by the uterine wall, making it a mutual activity.

More firmly attached by the 7th day

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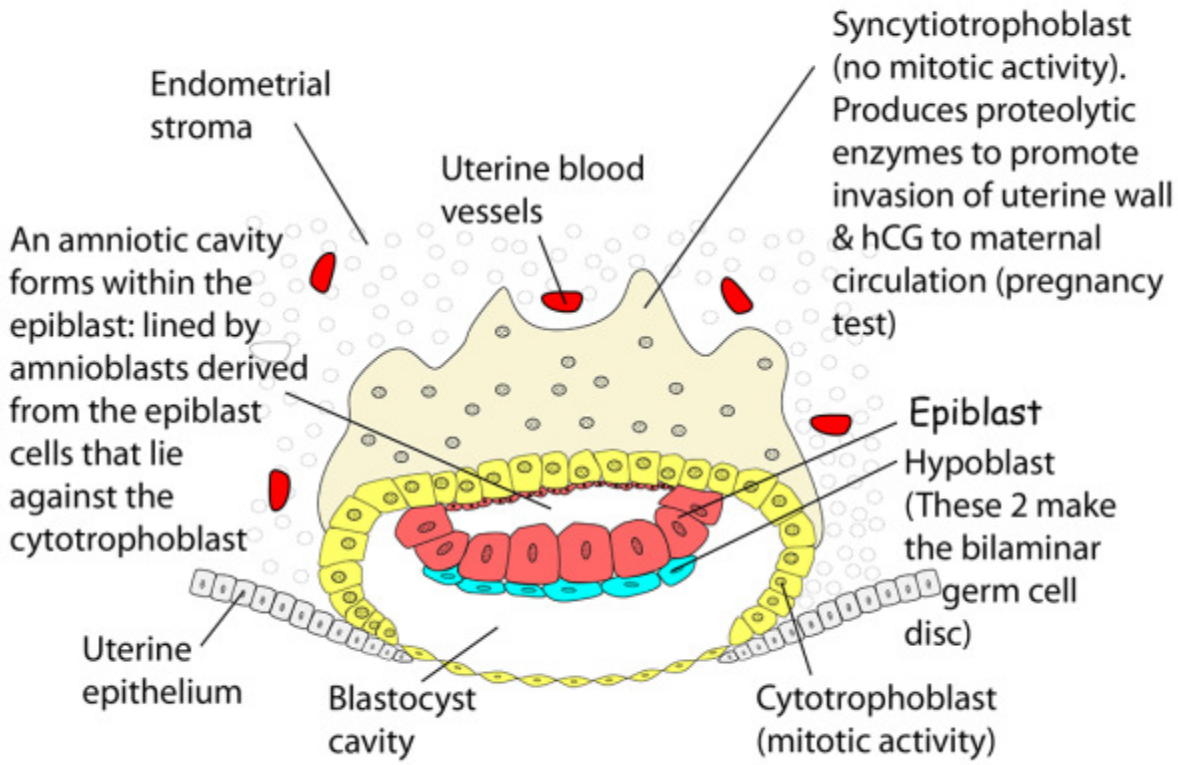
FURTHER (8th DAY) IMPLANTATION OF BLASTOCYST



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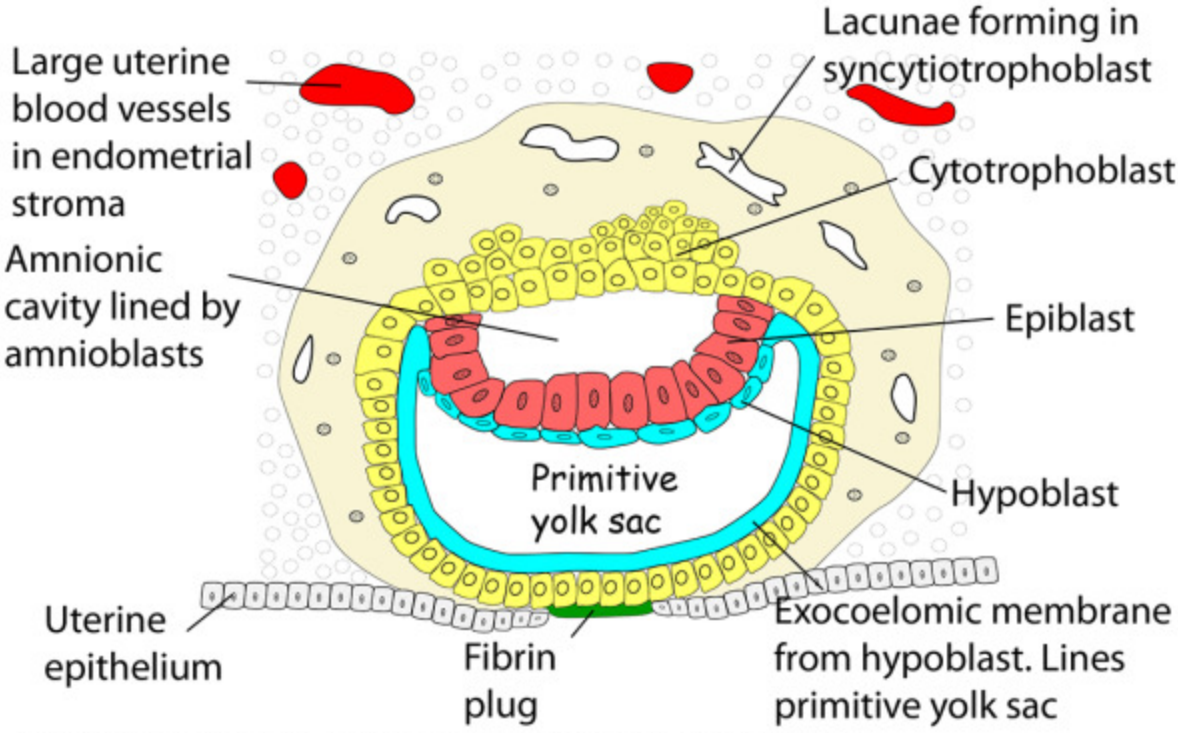
LACUNAR STAGE (9th DAY) IMPLANTATION OF BLASTOCYST



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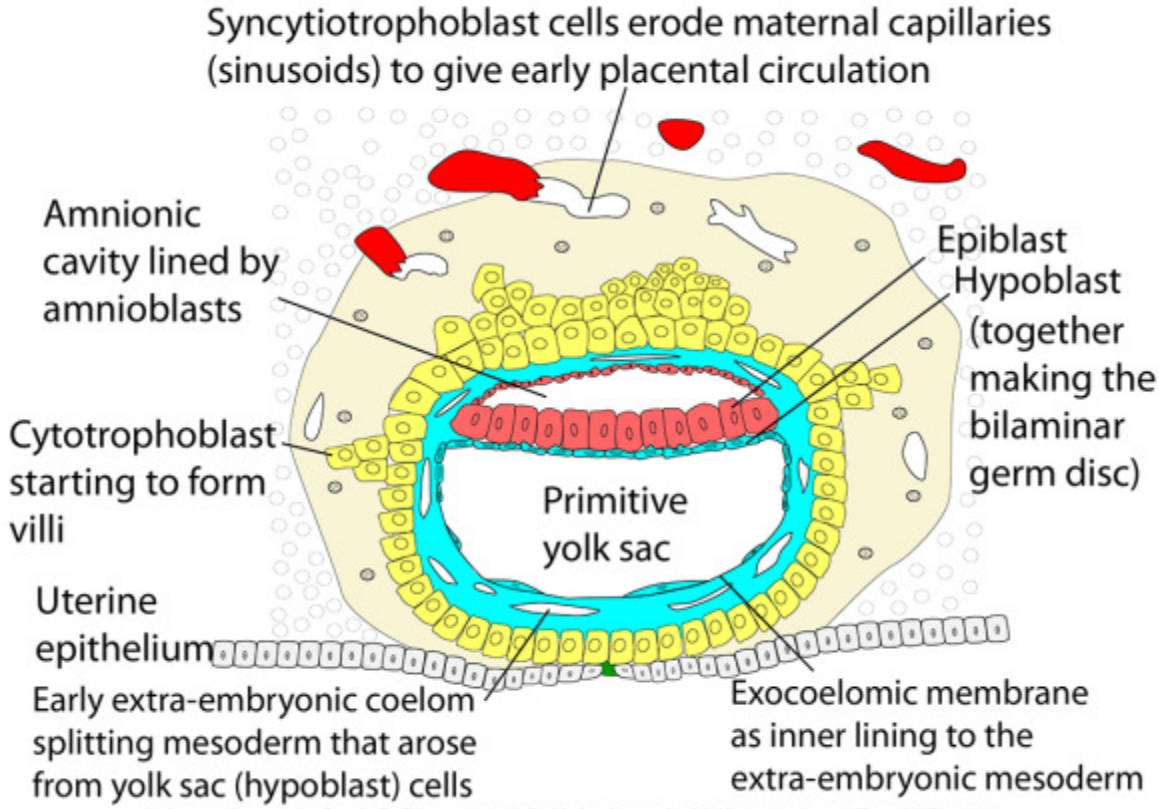
12th DAY IMPLANTATION OF BLASTOCYST



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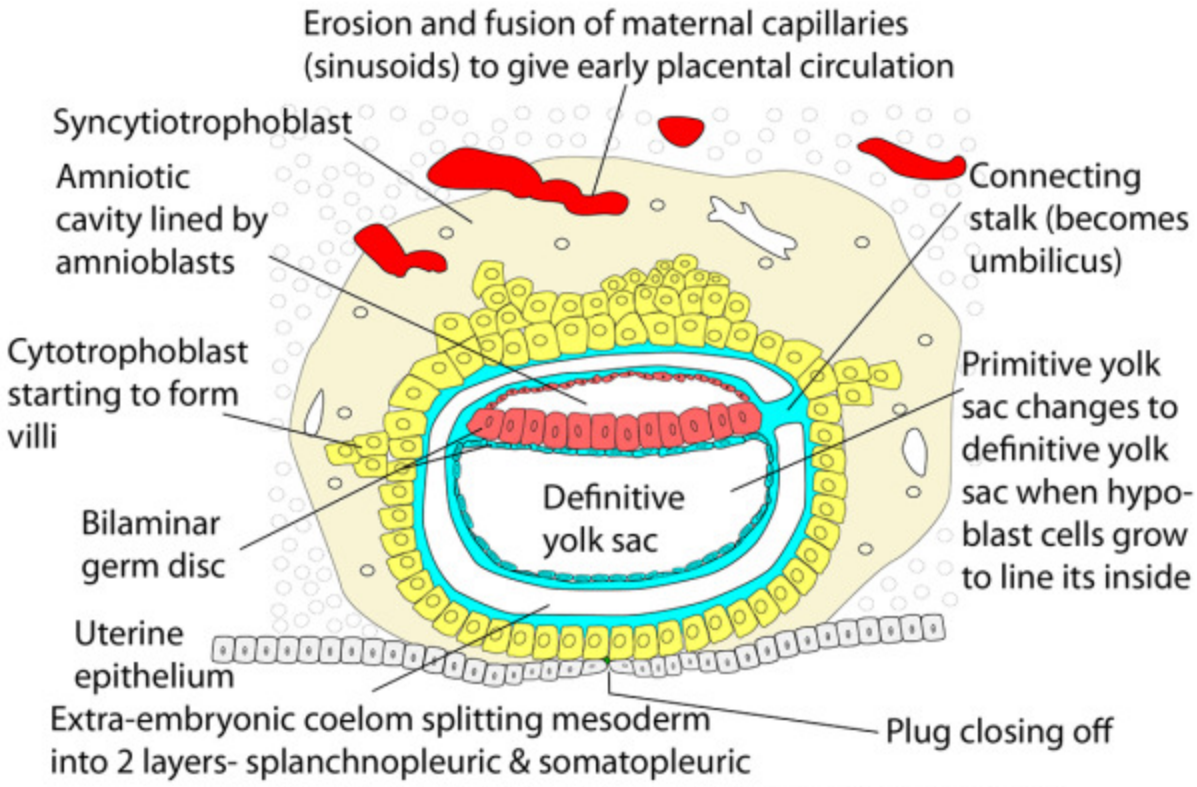
12/13th DAY IMPLANTATION OF BLASTOCYST



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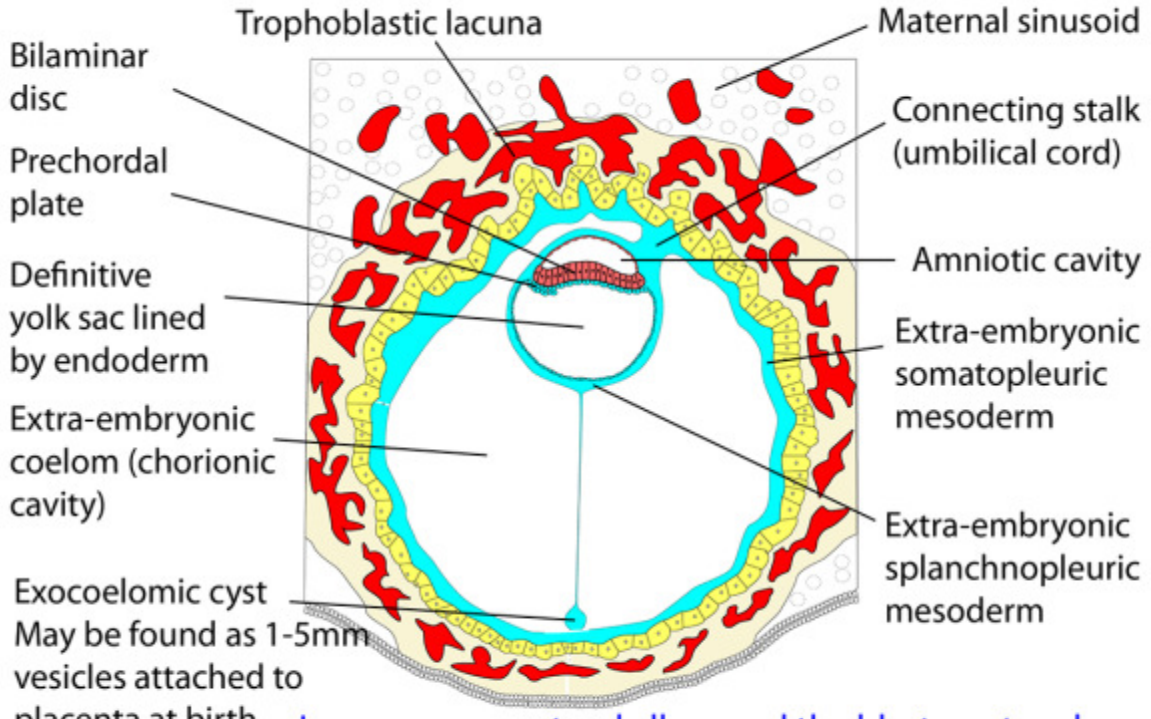
13th DAY IMPLANTATION OF BLASTOCYST



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