

# METHODS

## Primordial Germ cells

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- Any biological cell that gives rise to the gametes of an organism that reproduces sexually is termed germ cell.
- Hence progenitor cells that give rise to gametes are referred to as primordial germ cells.
- Germ cells that still have to reach the gonads are primordial germ cells, precursor germ cells, or gonocytes.

# Introduction

- In mammals generally, a few cells in the pre-embryonic stage are induced by signal transduction of neighbouring cells to become primordial germ cells.
- The beginning or first discernible indication of an organ or structure is referred to as primodium (*anlage, rudiment*).

## Characteristics

- Characteristically they divide repeatedly on their migratory route through the gut and into the developing gonads
- During gastrulation these group of cells are set aside to form oocyte or spermatozoa, they migrate through the posterior endoderm, which forms the hind gut from there to genital ridge which is the site of developing gonads.

# Establishment of the germline

Two different ways in different organisms

- Preformation (segregation)
- Epigenesis (recreation)

## Preformation

- Germ cells determinants (germ plasm) are set aside before or at fertilization and remain segregated throughout the lifespan of the organism.

## Epigenesis

- Primordial germ cells are generated during development. Seen in all mammals and many other species, germ cells are "set aside" before other cell types.

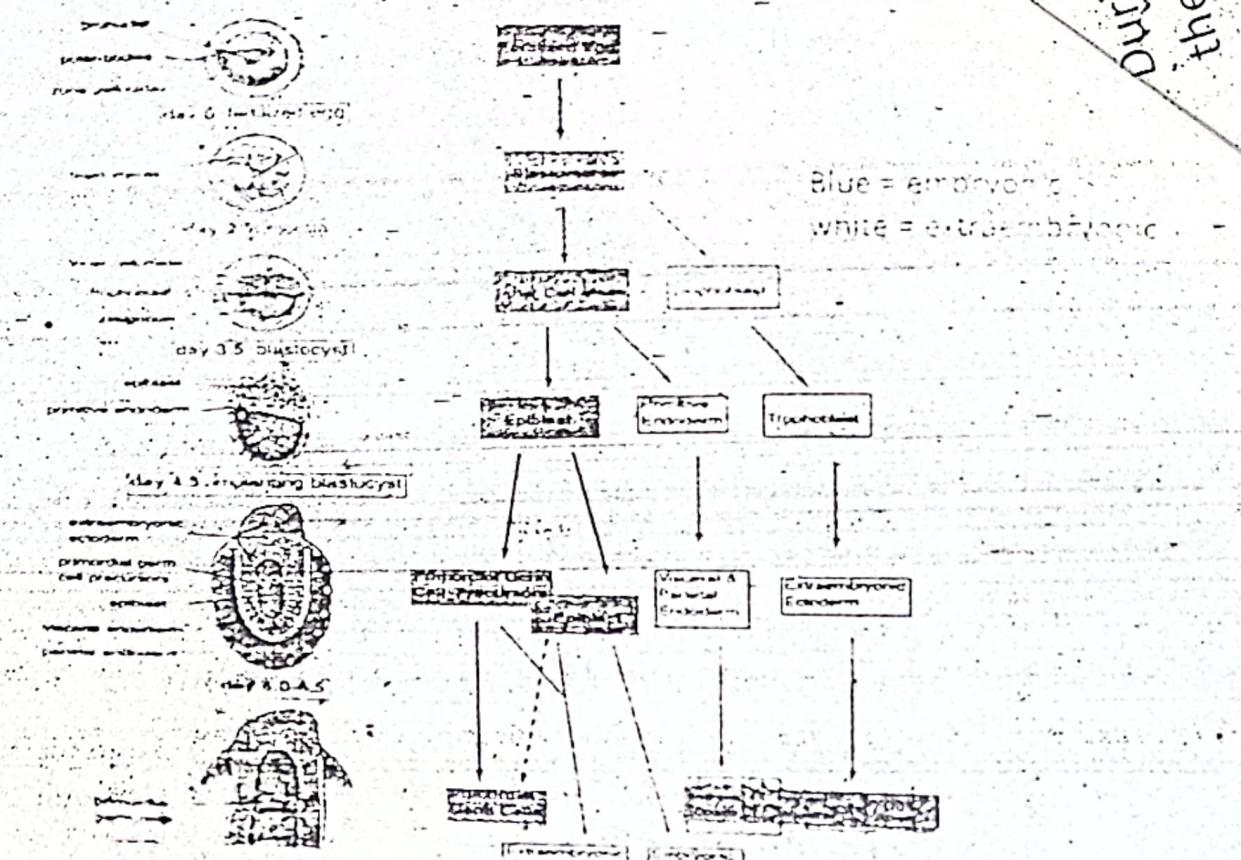
## Primordial germ cells.

### Description.

- Are large, spherical sex cells, visible among the endodermal cells of the umbilical vesicle (yolk sac) near the origin of the allantois.
- During folding of the embryo, the dorsal part of the umbilical vesicle is incorporated into the embryo.



# Epigenesis of germline



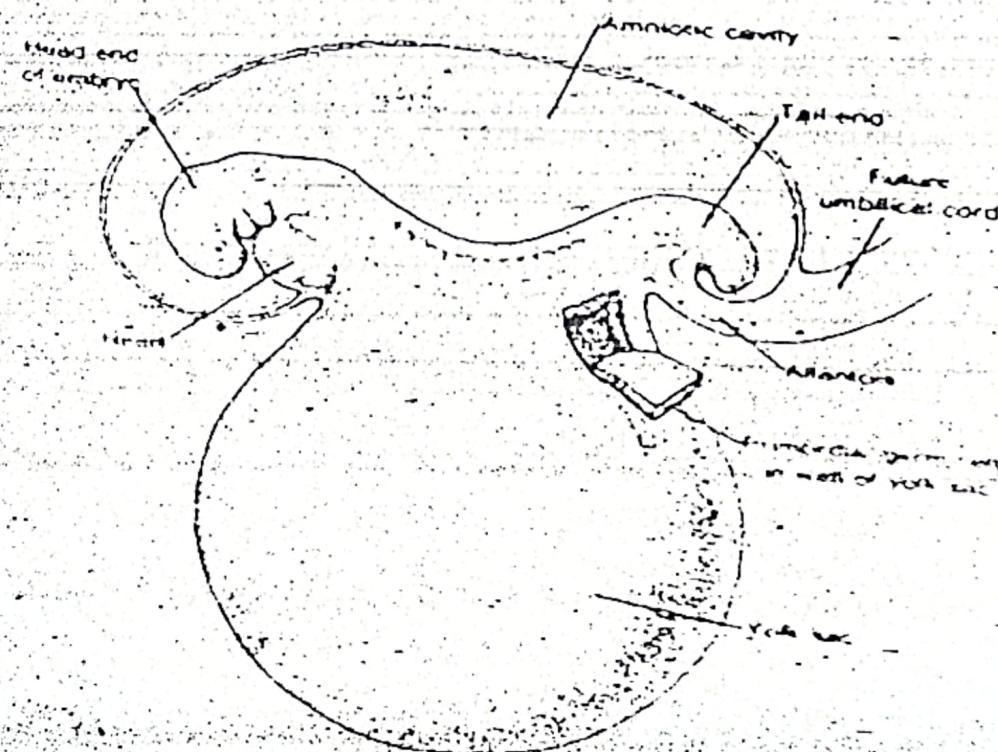
## Descendants and Migration

- The pgc are the common origins of spermatozoa and oocytes and thus represent the germline ancestors ,they are diploid and can be recognised in the epiblast in the 2<sup>nd</sup> week.
- In the 3<sup>rd</sup> week, the pgc wander amoebically from epiblast into the yolk sac wall and collect near the exit of the allantois, to become extraembryonal lying in the endoderm and mesoderm of the yolk sac wall.

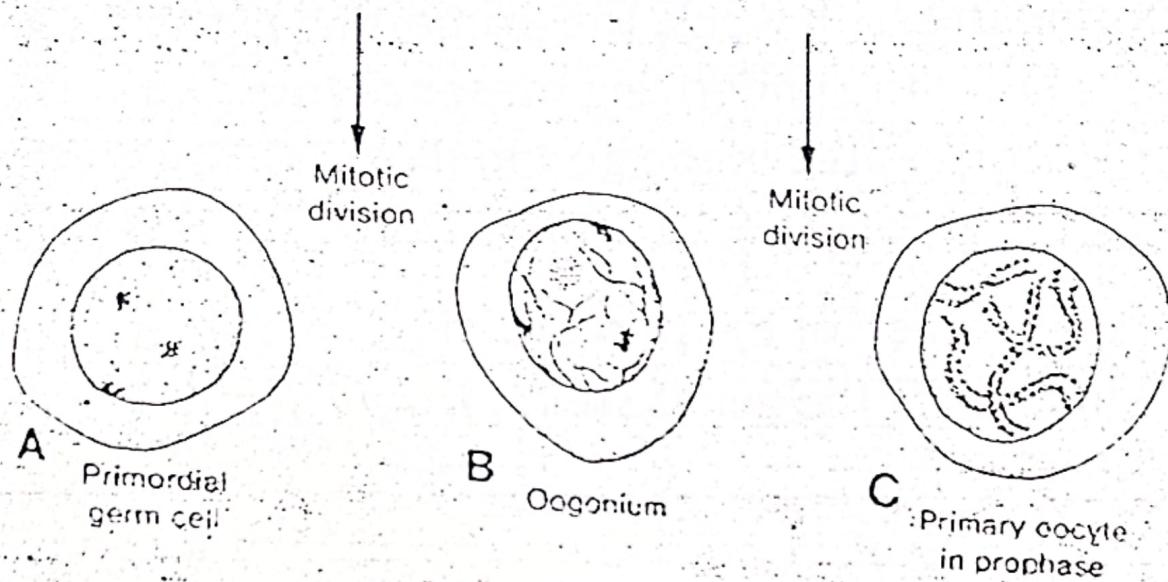
# Differentiation

- During the fourth week they begin to migrate from the yolk sac towards the developing gonads, where they arrive by the end of the fifth week.  
Mitotic divisions increase their number during their migration and also when they arrive in the genital ridge.
- In preparation for fertilization, germ cells undergo gametogenesis, which includes; meiosis, and cytodifferentiation former to reduce chromosomes number and latter to complete their maturation.

A three week old embryo, showing the primordial germ cells in the wall of the yolk sac, in the proximity of the future umbilical cord



# PGCs undergoing mitotic division



## Colonisation

- Craniocaudal curvature and lateral folding of the embryo lead to movement of the PGC back to embryo again between the 4-6<sup>th</sup> week. As this occurs, they migrate along the dorsal mesentery of the hindgut to the gonadal ridges, and move along the yolk sac wall to the vitelline and rectal wall.
- After crossing the the dorsal mesentary they colonise the gonadal ridge.

- During the sixth week, the primordial germ cells enter the underlying mesenchyme and are incorporated in the gonadal cords.
- The migration of the primordial germ cells is regulated by the genes *stella*, *fragilis*, and *BMP-4*.

## Differentiation

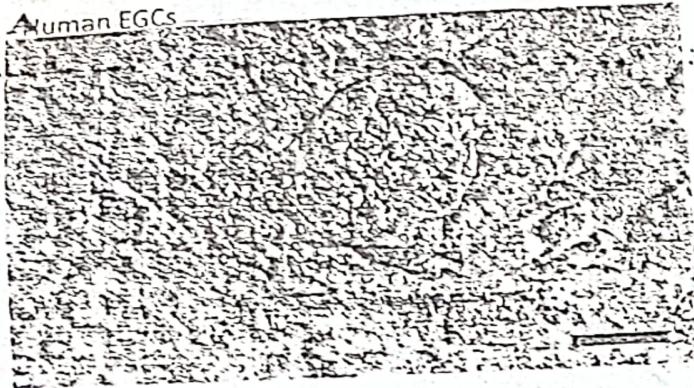
- Differentiation of primordial germ cells into oogonia begins shortly after their arrival in the ovary. By the third month of development, some oogonia give rise to primary oocytes that enter prophase of the first meiotic division.
- This prophase may last 40 or more years and finishes only when the cell begins its final maturation. During this period it is diploid.

- In the male and female , primordial germ cells form spermatogonia and oogonia respectively.
- After repeated mitotic divisions in the latter, some of these are arrested in prophase of meiosis I to form primary oocytes.
- Hence gametes are derived from primordial germ cells that are formed in the epiblast during the second week which later moved to the wall of the yolk sac.

- Maintenance of pluripotency within this cell population may arise through epigenetic modifications that suppress somatic differentiation programs
- Transformation of these population of cells lead to germ cell tumour
- Pgc are thus termed the progenitors or ancestors of the sex cells.

# Human Embryonal Germ Cells

## Assignment



Short notes on;

- Unipotent cell.
- Multipotent cell.
- Pluripotent cell
- Totipotent cell.

- (a) Embryonic Stem cell.
- (b) Embryonic Germ cell.