2nd Semester 2021-2022

Embryology

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Year 2

Introduction

Embryology is the sequential stages of embryonic and fetal development, beginning with fertilization.

- The embryonic development include all the processes where by single cell the fertilized egg or zygote give rise to first an embryo, then a fetus which at birth has the capacity to adept to post natal life.
- The intra uterine development is often divided into an embryonic period and fetal period.

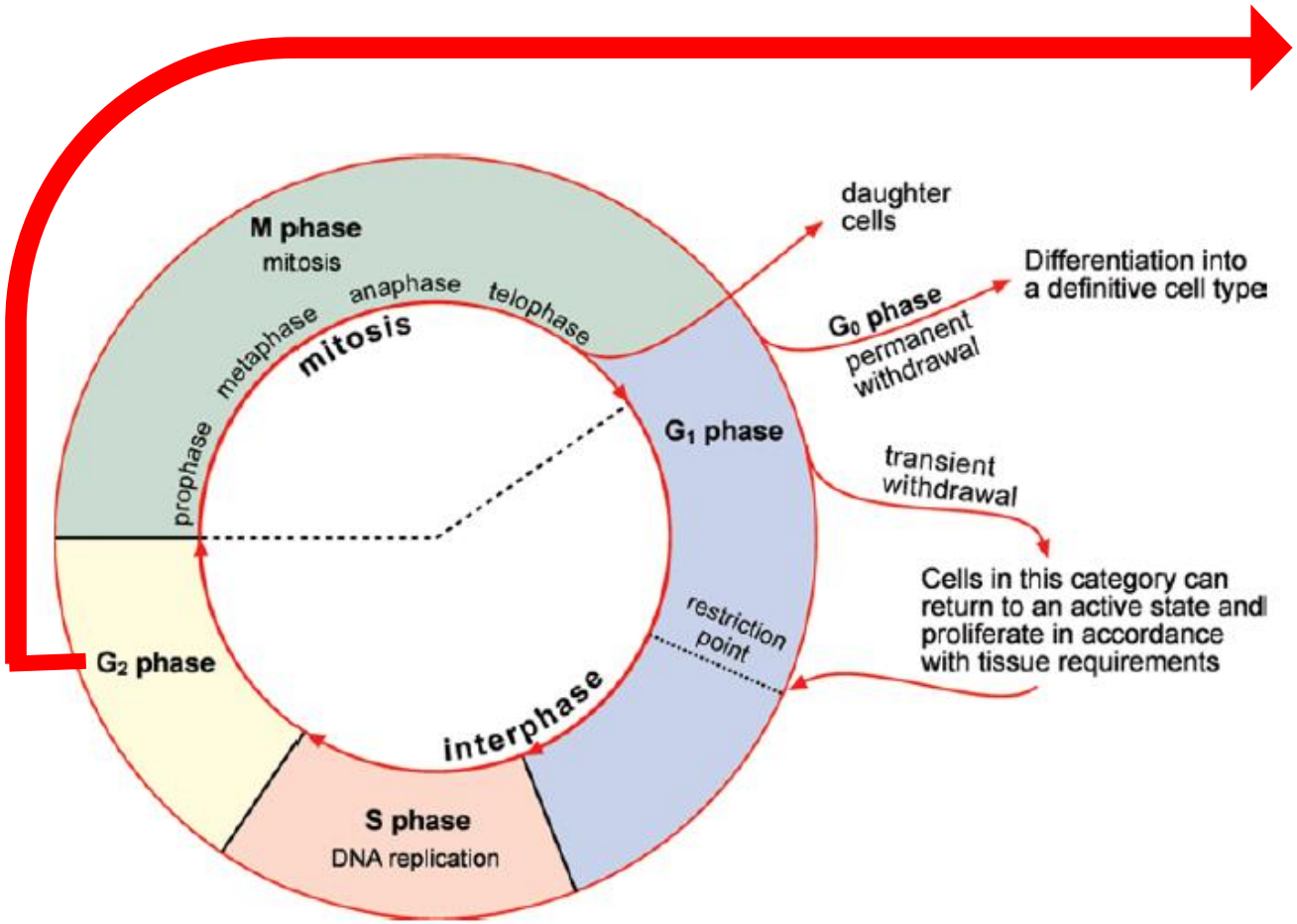
1. **Embryonic period:** It is the time from fertilization when the Oocyte is penetrated by the spermatozoon , to the earliest (primordial) stages of organ development (about 30 days in dog , cat , sheep , pig , almost 60 days in horse , cattle and human .
2. **Fetal period:** The time between the embryonic period and parturition (the end of gestation) during which organs grow and begin to function

- The development of the organism does not stop with birth, however organs continue to grow and maturation at least until puberty and many tissues need continuous replacement throughout life .
- Essentially all higher animals start their lives from a single cell, the fertilized ovum zygote .
- The time of fertilization , where the spermatozoon meets the egg.

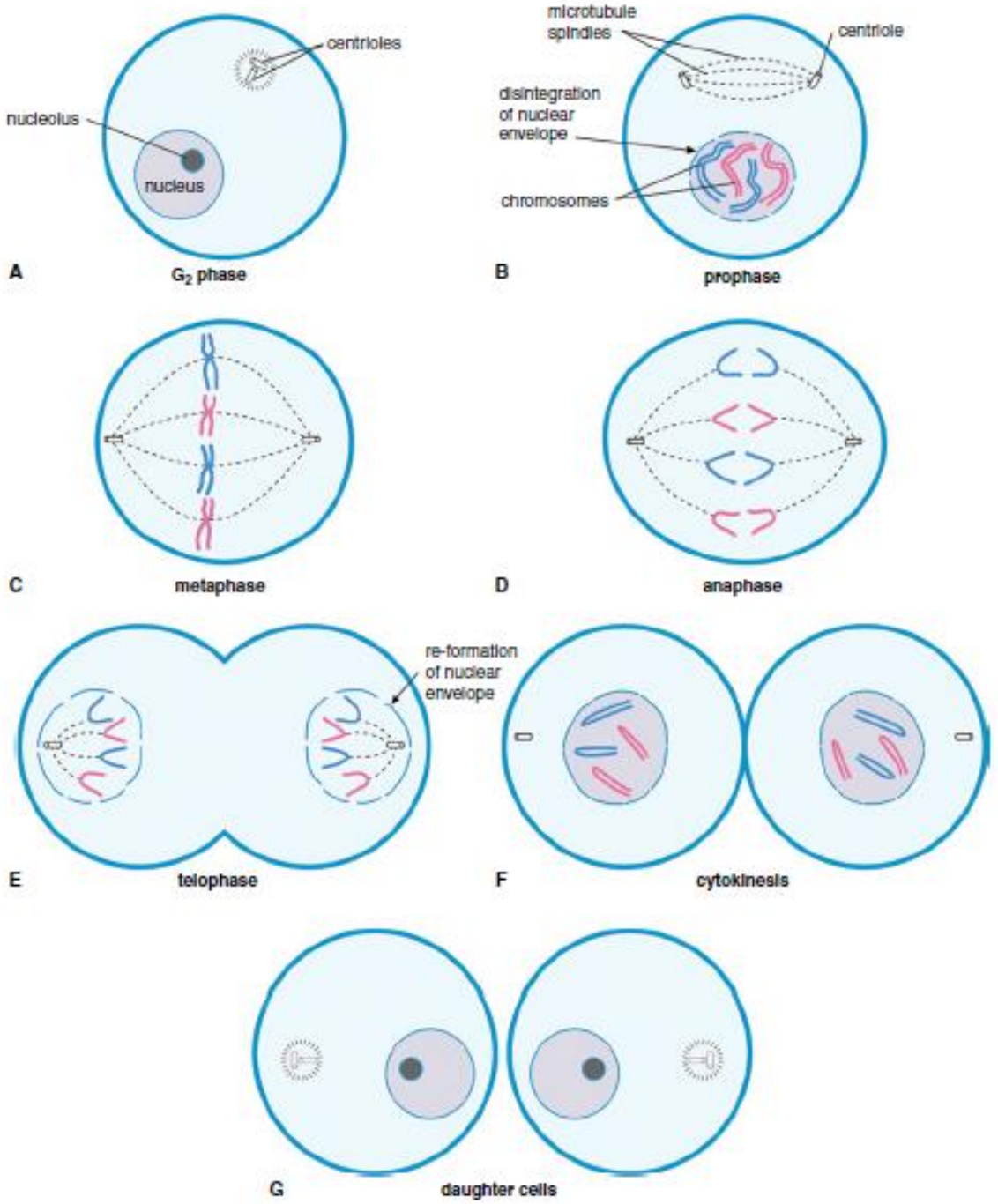

F I
S I
T I
C I
H I
C I
R I
M I
F II
S II
T II
C II
H II
C II
R II
M II
F III
S III
T III
C III
H III
C III
R III
M III
F.Fish.
S.Salamander.
T.Tortoise.
C.Chick.
H.Hog
C.Calf
R.Rabbit
M.Man

Division, Growth and Differentiation of cells

- Mitosis is used to describe nuclear division of somatic cells, a process which usually results in the production of two cells with the same chromosome complement.
- Mitosis is essential for embryonic growth and development and for repair and replacement of tissue throughout life. The stages of mitosis occur as a distinct sequence of cytological events which are part of the cell cycle.
- Mitosis can be divided into four stages, **prophase**, **metaphase**, **anaphase**, **telophase**, followed by cytoplasmic division, **cytokinesis**.
- In somatic cells, the highly regulated cell cycle can be divided into four sequential phases, namely G1, S, G2 and M, and a quiescent phase, G0.
- In germ cells, cell division referred to as meiosis takes place, where the daughter cells contain half the number of recombined chromosomes of the progenitor germ cell.



Stages in somatic cell division indicating the major phases of the cell cycle.



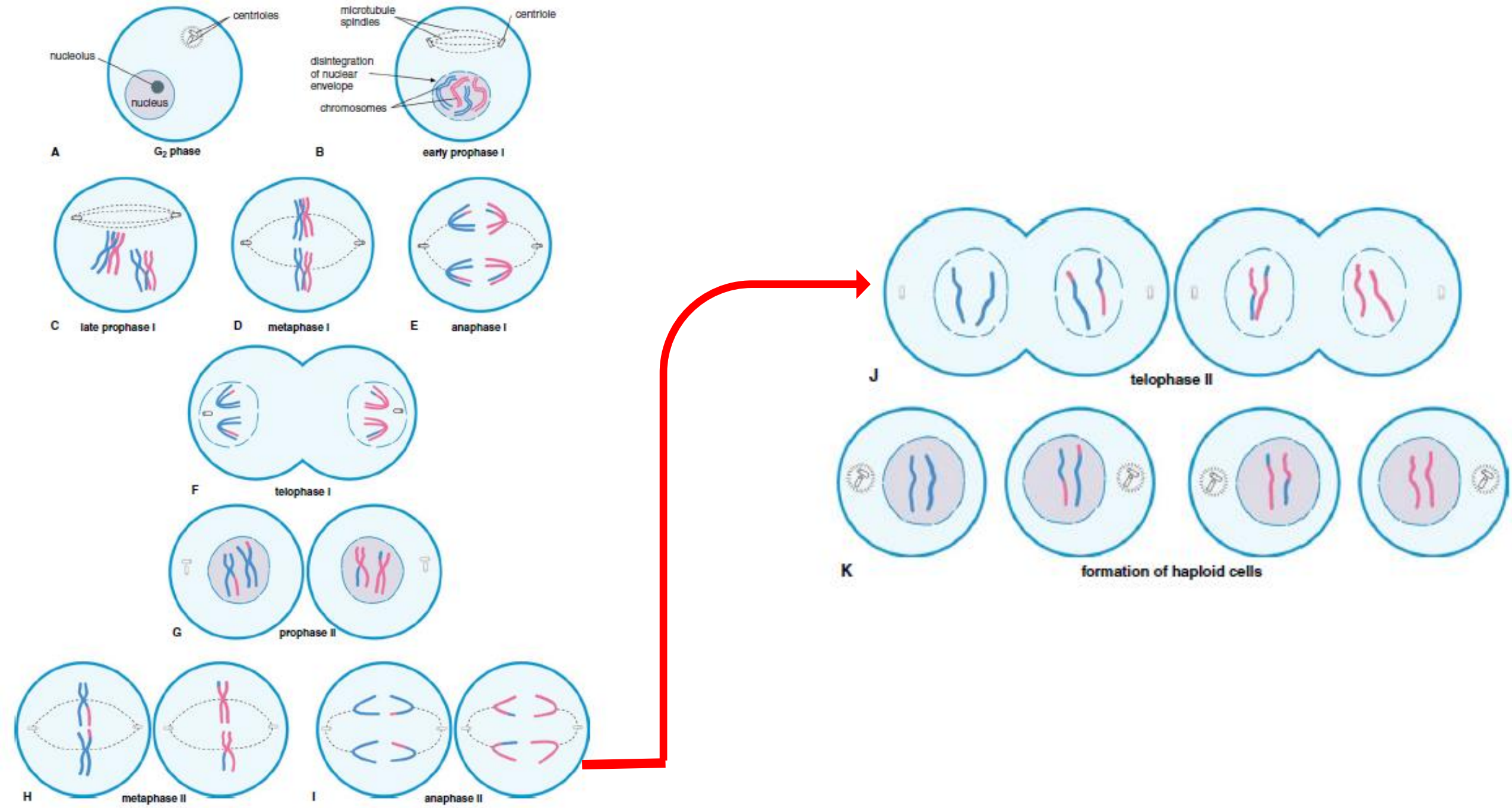
The number of chromosomes in human and animals diploid cells

Species	Number of chromosomes (2n)
Humans	46
Cats	38
Cattle	60
Chickens	78
Dogs	78
Donkeys	62
Goats	60
Horses	64
Pigs	38
Rabbits	44
Rats	42
Sheep	54

Meiosis

Meiosis, which occurs only during gametogenesis, differs from mitosis in several respects:

1. This form of cell division is termed a ‘reduction’ division. The resulting gametes which are haploid are given the designation ‘n’.
2. There is a reciprocal exchange of genetic material between non-sister chromatids.
3. The resulting gametes are products of the random segregation of maternally-derived and paternally-derived chromatids.
4. Meiosis is divided into two stages, meiosis I and II.
5. Following G2 phase, meiosis I consists of prophase I, metaphase I, anaphase I and telophase I. The amount of DNA in a cell entering prophase I doubles.
6. At the end of telophase II, nuclear envelopes form around each set of chromatids and the cytoplasm divides again. As a consequence of meiosis I and II, four haploid cells are formed from a single diploid germ cell.


centrioles
nucleolus
nucleus
A
G2 phase
microtubule spindles
centriole
disintegration of nuclear envelope
chromosomes
B
early prophase I
C
late prophase I
D
metaphase I
E
anaphase I
F
telophase I
G
prophase II
H
metaphase II
I
anaphase II
J
telophase II
K
formation of haploid cells

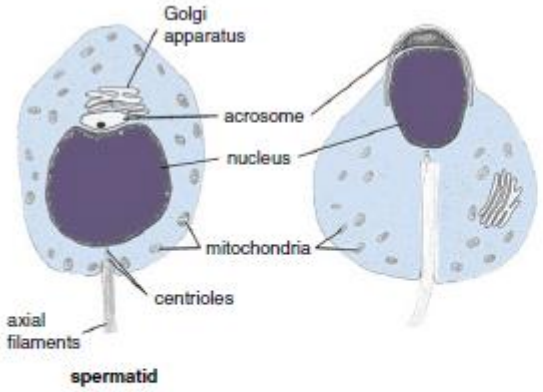
Gametogenesis

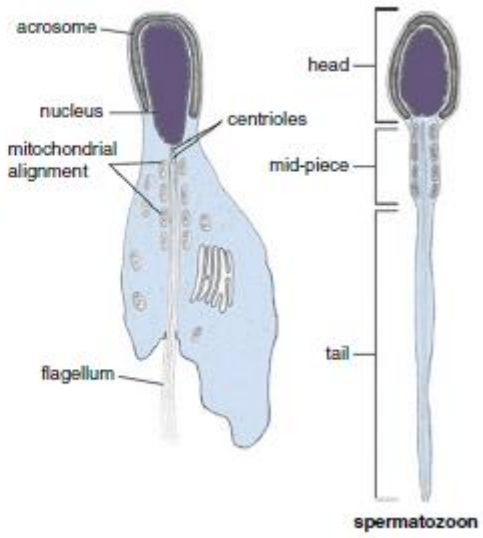
- It is the sequential stages in the differentiation and maturation of primordial germ cells into gametes in male and female animals
- Primordial germ cells (PGCs) originate from the epiblast of the inner cell mass and migrate to the developing gonads where they undergo a series of mitotic divisions, producing stem cells.

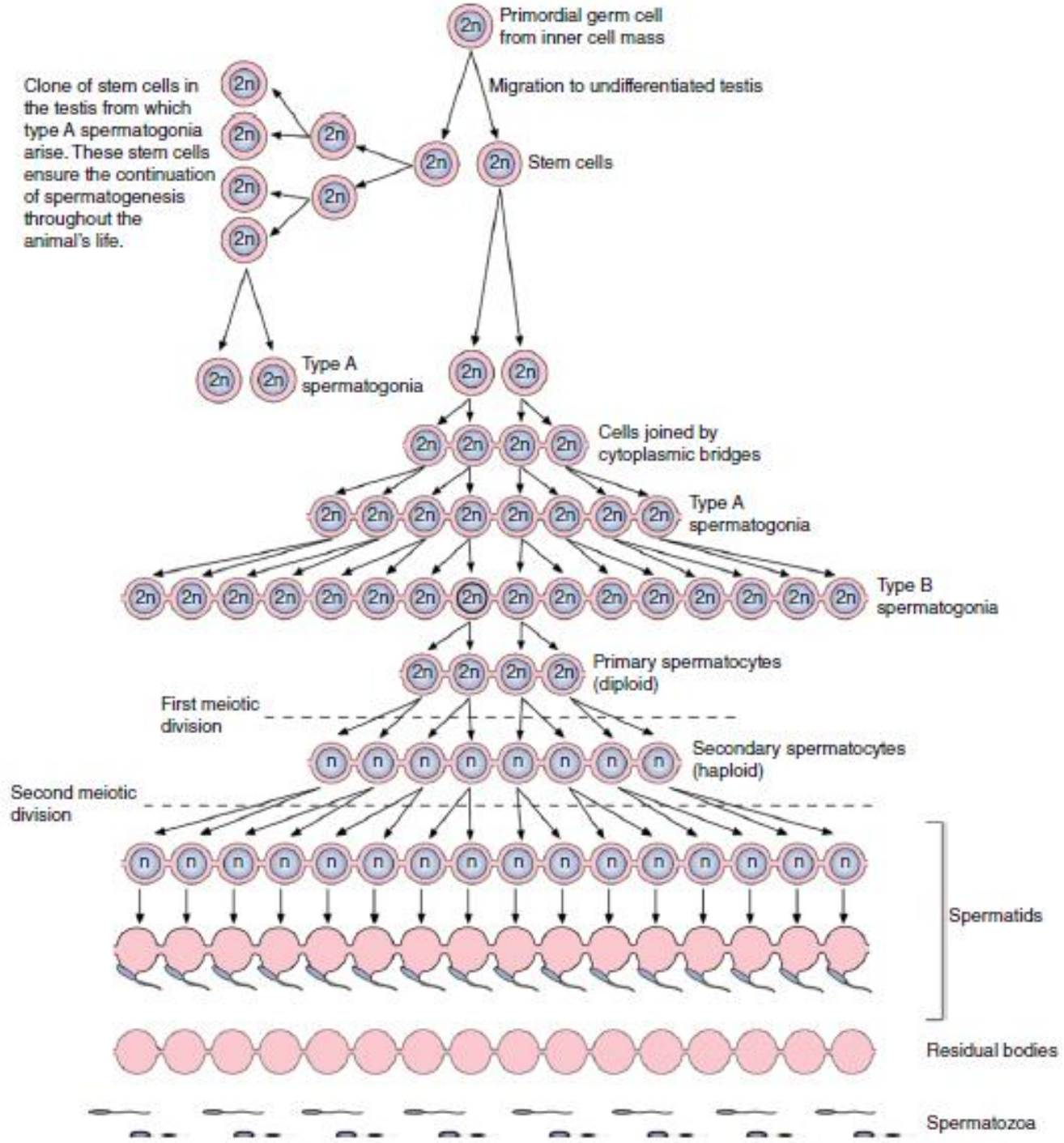
- **In male mammals**, these stem cells remain dormant until puberty; when activated, the stem cells develop into two populations of spermatogonia (type A and type B). Type B spermatogonia differentiate into spermatozoa.
- **Spermatogenesis** is the production of spermatozoa, which are haploid male gametes.

- **In female mammals**, oogonia develop from PGCs.
- **Oogenesis**: Oogonia undergo repeated mitotic divisions in the fetal ovary, developing into primary oocytes, which enter the first stage of meiosis. This process ceases soon after birth.
- Meiosis resumes at puberty, resulting in the release of secondary oocytes at ovulation.
- Only small numbers of oogonia develop into primary oocytes, the remainder undergoing degeneration (atresia).

- **Spermatogenesis**
  is the production of spermatozoa, which are haploid male gametes.







Oogenesis, which begins in fetal life, is not completed until animals are sexually mature. Oocytes, gametes produced by female animals, provide the maternal genetic material and nourishment for the developing zygote