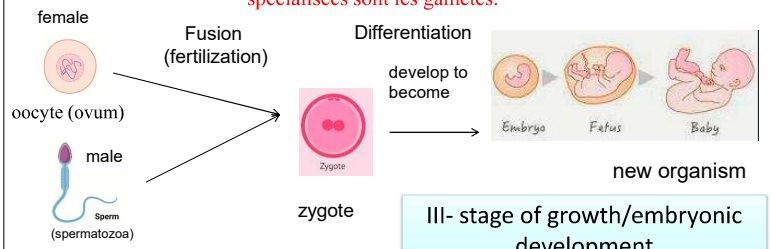
Embryology

Definitions

•**Embryology**: A continuous process that begins when an oocyte (ovum) is fertilized by a sperm to form a zygote which differentiates in to definitive organ system and thereafter in to their early functional stage.

Sexual reproduction : is carried out through the reunion of gametes (sex cells)
c'est un phénomène très important chez les métazoaires, il implique des cellules spécialisées sont les gamètes.



III- stage of growth/embryonic development

I- pre-embryonic

II- fertilization

Stages of embryogenesis
Embryonic Development

I- pre-embryonic Gametogensis

II- fertilization Zygote

III- stage of growth/embryonic development

مراحل التكوين الجنيني في طوائف الحيوان

III- stage of growth/embryonic development

I- Embryogenesis

1- Cleavage → morula

2- Gastrulation

3- Neurulation

Blastula

Gastrula

Neurula

II- Organogenesis

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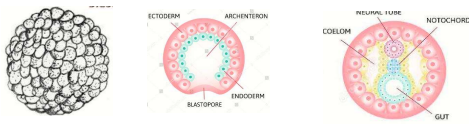


Gametogenesis = process of formation of gametes

❖ **Site** Gonads → Testis in men / Ovary in women

❖ Production of 2 cell types:

- ➢ **Spermatogenesis** → sperm (male gamete)
- ➢ **Ovogenesis** → ovum (female gamete)

❖ Sperm and ovum → **haploid** cells with **N** chromosomes

❖ Production → reductional mitosis = meiosis

❖ Gametogenesis includes, in addition to the division phases, a maturation phase → final form of the gametes.

❖ There are differences between spermatogenesis and oogenesis.

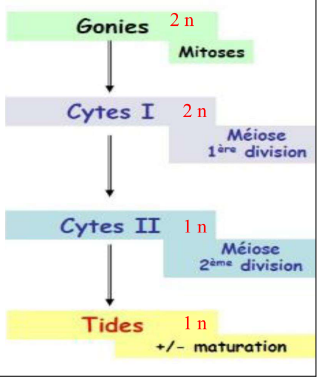
❖ But, common stages exist between spermatogenesis and oogenesis.

❖ Both types possess three main phases:

1 .Period of multiplication: *diploid* germ cells (**-gonia**) divide by mitosis and multiply in number

2 .Period of growth: During these phase **-gonia** grow into primary auxocytes **(-cyteI)**.

3 .Period of maturation:
marked by meiosis. **Auxocytes I** become *haploid*, secondary auxocytes **(-cytes II**), then, after the 2nd division of meiosis, **-tides**. During this phase, ***cytodifferentiation*** also occurs, leading to anisogamy and resulting in the formation of functional gametes.



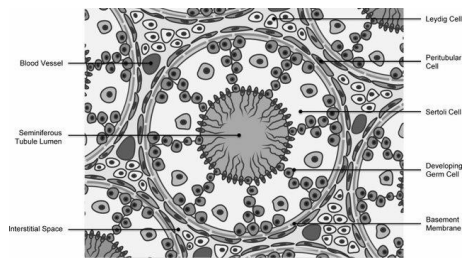
Spermatogenesis

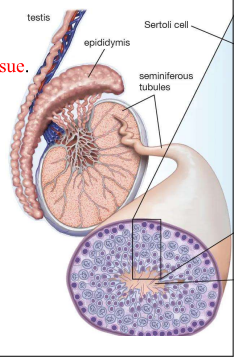
* Sperm formation

* It occurs in : the wall of the seminiferous tubules (testis)
* In humans this process is **permanent** and **not cyclical**.
* starts at **puberty** and generally continues uninterrupted until death.
There could be a slight decrease in the quantity of sperm with increase in age.

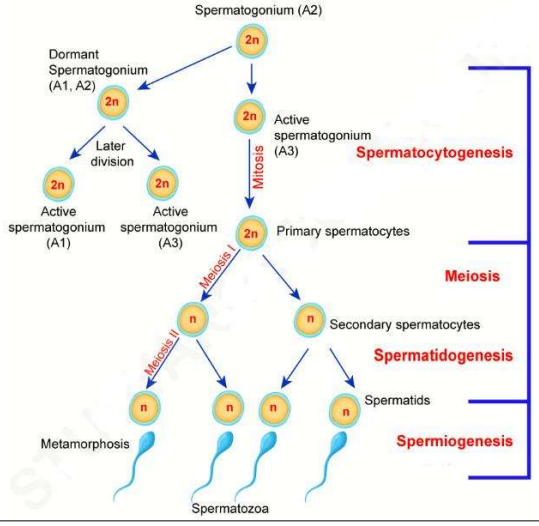
Structure of the testis

Between the seminiferous tubules are clusters of **Leydig** cells associated with blood capillaries in an interstitial in(t)ər'stiSHəl tissue.





Stages of spermatogenesis

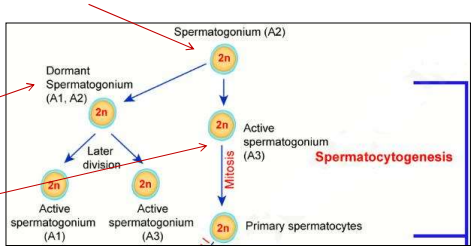


Stages of spermatogenesis

1 .Period of multiplication: *diploid* germ cells (**-gonia**) divide by mitosis and multiply in number

In the basal part of the seminiferous tubule, **spermatogonia** (2n chromosome and 2n DNA) divide by successive mitoses and multiply.

Some of their daughter cells become spermatogonia (stem cells) and are capable of continuing to multiply by mitosis.



Others stop multiplying and start the growth stage.

These cells are connected to each other by cytoplasmic bridges.

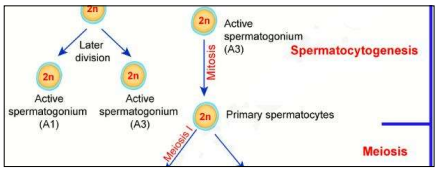
Stages of spermatogenesis

2 .Period of growth: During these phase **-gonia** grow into primary auxocytes **(-cytel)**.

The spermatogonia in this phase synthesise a lot of RNA, accumulate reserves and grow in volume.

They are called spermatocytes (I) (2n).

Each spermatocyte (I) replicates its DNA and starts meiosis at puberty.



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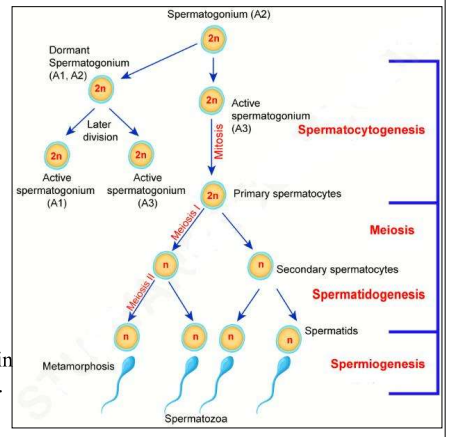
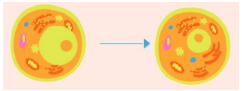


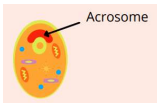
Spermiogenesis

Transformations des spermatides en Spermatozoïdes .

***Condensation du noyau:**
compaction et réduction du noyau, condensation du contenu du noyau à un volume minimal.



***** formation de l'acrosome:**
formation d'un capuchon céphalique (acrosome) contenant des enzymes qui jouent un rôle important dans la pénétration de la zone pellucide de l'ovocyte.



***** formation du flagelle:**
formation de la queue du spermatozoïde

***** Réduction du cytoplasme :**
rejet de tous composants cellulaires inutiles du cytoplasme.

Oogenesis

I.

Definition

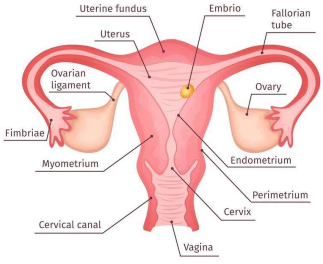
Oogenesis is the process of formation of the female gamete, ovum in humans, which is haploid and contains 23 chromosomes.

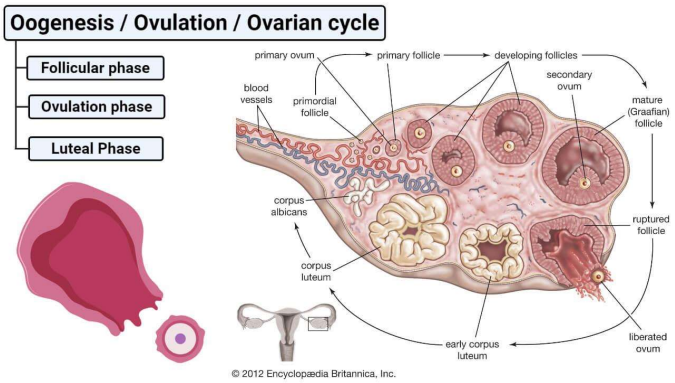
The formation of **oogonia** starts before birth and ends at the age of 45-50 called **menopause**.

Oocytes
~2 million at birth
~40,000 at puberty
~400 ovulated over lifeti

It occurs in the **ovaries**.

It is a discontinuous process (cyclical), beginning during **foetal** life and ending at the **menopause**.





II. Phases of ovogenesis

A) Multiplication phase:

The **ovogonia** (2n) divide by mitosis and give a **non-renewable stock.**

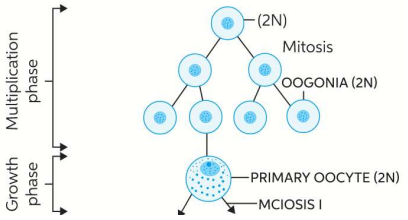
In women this phase takes place during embryonic and foetal life.

B) Growth phase :

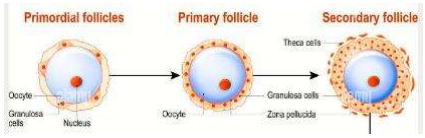
Before birth, the ovogonia stop multiplying and enter prophase I (meiosis I), where they become blocked.

The cells **grow** in volume and develop into **ovocytes** I (2n).

Each of these cells is surrounded by a layer of follicle cells to form a "**primordial follicle**".



- *From birth*, a series of waves of ovocytes I grow and develop a remarkable volume increase without cell division (they remain blocked in prophase I).
- The primordial follicle is transformed into a **primary follicle** and then into a **secondary follicle** by multiplication of the *follicular cells*.
- It should be noted that the primordial follicles and the ovocytes I they contain regress in large numbers between birth and puberty; only 400,000 will remain at puberty.
- Fewer than 500 will develop to ovulation during the woman's genital life.



C) Maturation phase :

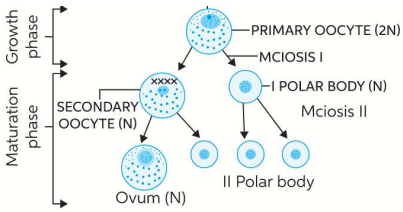
Between puberty and menopause and cyclically, ovocytes I complete meiosis I and give **ovocytes II** (n chromosomes, 2q DNA) with emission of the **1st polar globule** (n chromosomes, 2q DNA).

This division is very unequal, with ovocyte II guarding the totality of the cytoplasm.

Immediately afterwards, meiosis II begins. But the process is blocked once again (in metaphase 2).

If there is no fertilisation, the oocyte II remains at this stage of meiosis and then rapidly degenerates.

If fertilisation occurs, the oocyte II will complete its maturation and become a **mature ovum** with the emission of the **2nd polar globule**



III. Folliculogenesis :

- This is the ***process*** by which a primordial follicle develops to ovulation or regresses by apoptosis.

The follicle : is a structure in the ovarian cortex, consisting of an oocyte surrounded by follicular cells.

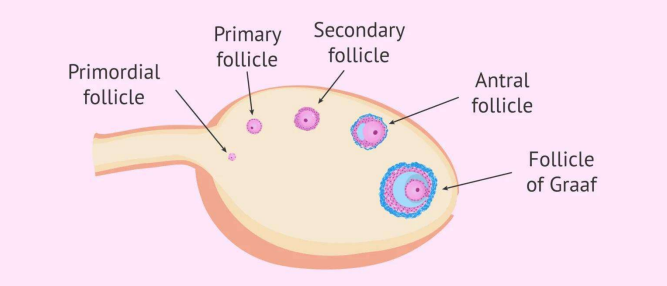
There are different types of follicles corresponding to stages of progressive development of the same morphological structure; these are chronologically

1) **the primordial follicle**
2) **the primary follicle**
3) **the secondary follicle**
4) **the tertiary follicle**
5) **the mature follicle or De Graaf follicle**

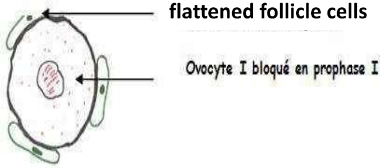
Development of the Follicles

What are the stages of folliculogenesis?

1. Primordial follicle
2. Primary follicle
3. Secondary follicle
4. Antral follicle
5. Graaf follicle

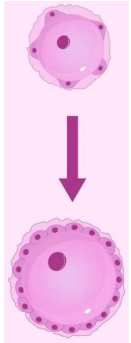


1. Primordial follicle

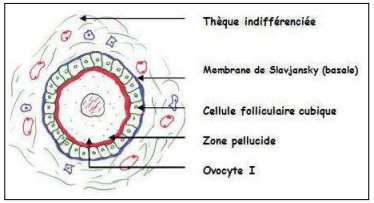


- The primordial follicle constitutes the first stage of follicular development. It is a follicle formed by an oocyte that is surrounded by a single layer of flattened **pre-granulosa cells**.
- These primordial follicles are formed in the fetal period of the female, beginning to form in approximately the third month of gestation.

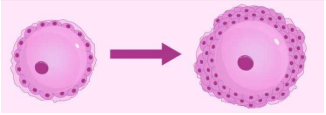
2. Primary follicle



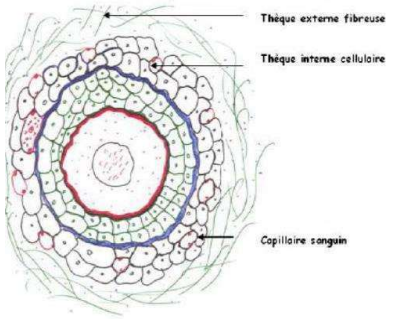
- The primordial follicles constitute the "reserve“ from which some of them will be stimulated to advance in their development to primary follicles.
- In the primary follicle stage, the **flat** cells that surrounded the oocyte in the primordial follicle now become **cubic** (die-shaped) . In addition, the oocyte itself increases in size.
- On the other hand, the **zona pellucida** that will surround the oocyte, which is composed of glycoproteins, also begins to form in the secondary follicle.



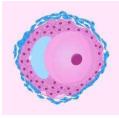
3. Secondary follicle



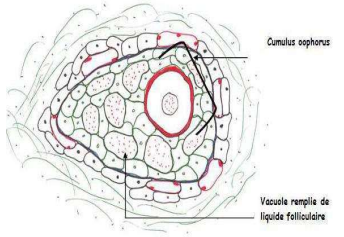
- In the secondary follicle stage, the cubic cells layers surrounding the oocyte are several, between 6 and 7 = **granulosa**.
- On the other hand, the **zona pellucida** that will surround the oocyte, which is composed of glycoproteins, also begins to form in the secondary follicle.
- At this stage, the granulosa cells continue to increase. *In addition*, the oocyte will also be surrounded by the **cells of the theca**, which will constitute the **inner theca** and the **outer theca**.



4. Antral follicle (or tertiary)

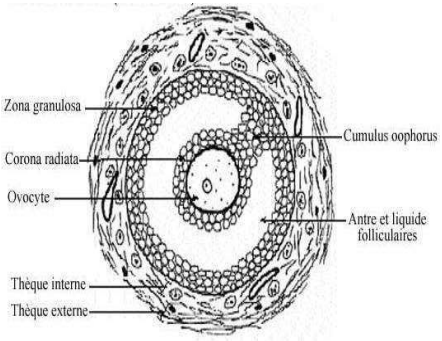


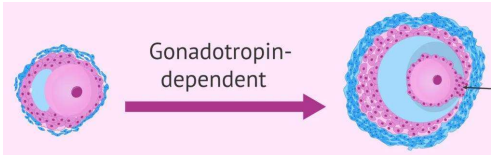
- The antral (or tertiary) follicle is characterized by the presence of a cavity filled with follicular fluid, known as the antrum ***antrum***.



5. De Graaf follicle

- The Graafian or pre-ovulatory follicle is the fully developed follicle, which will lead to ovulation of the oocyte it contains. Due to the growth of the antrum, the oocyte is located in one of the sides of the follicle. The oocyte, however, remains surrounded by ***granulosa*** cells, forming the ***cumulus oophorus*** or cumulus.





- Le corps jaune:

- Après l'ovulation, le follicule se transforme en corps jaune. La cavité se comble de cellules folliculaires, qu'on appelle cellules lutéales
- En l'absence de gestation, le corps jaune dégénère.