



**Exercise 1:**

Ovaries are active from puberty till menopause. In order to understand the endocrine role of ovaries on the genital activity, the following experiments are performed.

**Experiment 1:**

Two lots of female rats which did not reach puberty, 2 and 3, are subjected to ovariectomy with or without injection of ovarian extracts: estradiol and progesterone. The conditions and the results of the experiment are presented in document 1.

Groups	Conditions	Observed Results	
		Mass of the uterus	Uterine cycles
1	Control	710 mg	Cyclic variation
2	Ablation of two ovaries	120 mg	No variation
3	Bilateral ovariectomy + continuous and identical injections of ovarian extracts	705 mg	No cyclic variation

- 1- Draw out the roles of ovaries and their mode of action as revealed in this experiment.

**Experiment 2:**

Four lots (A, B, C and D) of female rabbits that did not reach puberty receive daily injections of 5 µg of estradiol (E) and/or 200 µg of progesterone (P) during several days. Then, transverse sections of their uterus are prepared at the end of the experiment, at day 11. Document 2 presents the experimental conditions as well as the obtained results.

- 2- Interpret the results of document 2.

**Experiment 3:**

Protein receptors for progesterone were revealed at the level of endometrium cells. The injection of estradiol provokes an increase in the number of progesterone receptors in the day following the injection.

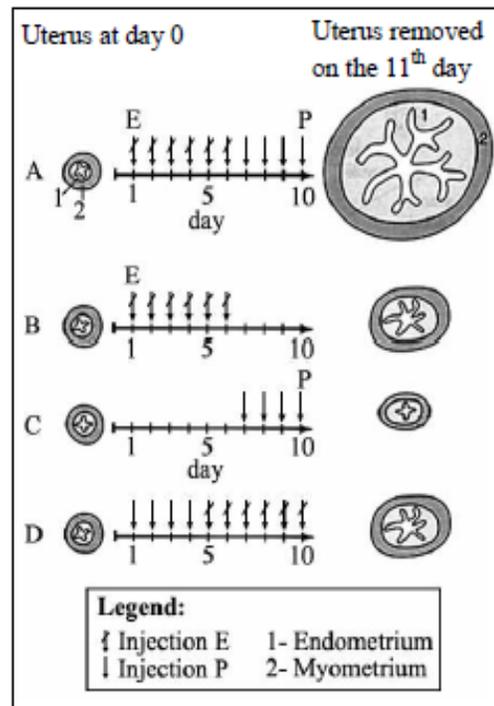
- 3- Explain the obtained results of lot A in experiment 2.

**Experiment 4:**

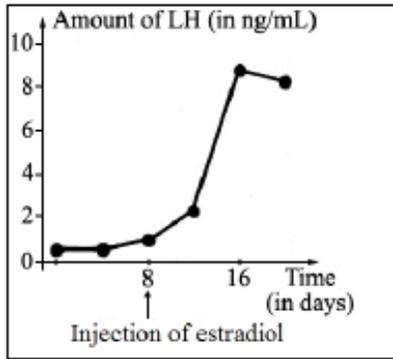
A lot of ovariectomized female mammals are subjected to injections of high amounts of estradiol with or without progesterone.

The evolution of the plasmatic concentration of the pituitary hormone LH is measure and the obtained results are shown in documents 3 and 4.

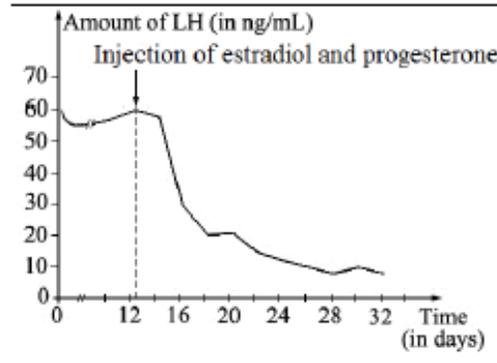
*Document 1*



*Document 2*



Document 3



Document 4

- Show, by referring to documents 3 and 4, that "the activity of the pituitary gland is under the control of ovarian hormones".
- Establish, by referring to all what precedes, a functional diagram showing the relations existing between the ovaries and the two other organs: the pituitary gland and the uterus.

### Exercise 2:

We are interested in studying the events that accompany the sexual reproduction in mammals. These events are studied at cellular and molecular levels.

Female rabbits were mated with sterile males in order to induce ovulation, and then they were inseminated with sperm cells taken from different levels of the genital tract of adult fertile male rabbits. One day following the insemination, the aspect of the cells that were taken from the oviducts was observed under the microscope.

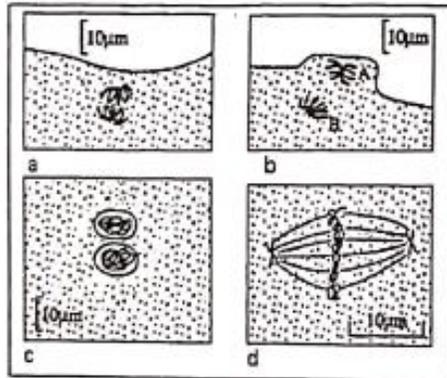
Document 1 presents the percentages of the two main aspects (schema X and Y) observed according to the site where the sperm cells were removed.

Site from where sperm cells were removed.		Aspect of the cells taken from the oviducts one day after the insemination	
		X	Y
	Testicle	100%	0%
	Proximal part of the body of the epididymis	85%	15%
	Distal part of the body of the epididymis	35%	65%
	Tail of the epididymis	8%	92%

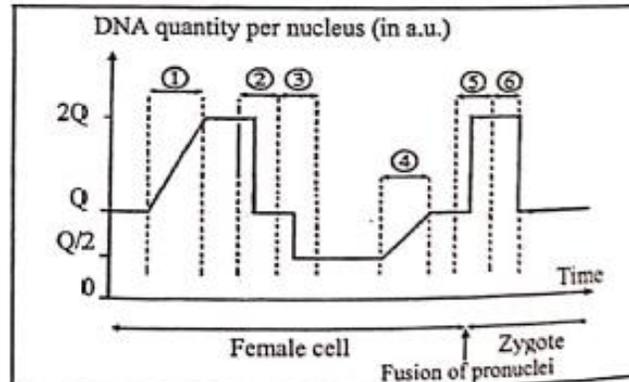
Document 1

- Explain briefly the structural modifications that take place during the passage of the cell from aspect X to aspect Y.
- Determine, by referring to document 1, the role of the epididymis.

Document 2 reveals, in chronological order, some steps of the evolution of the fertilized oocyte II and that of the zygote. Document 3 represents the evolution of the DNA quantity per nucleus of the female cell and that of the zygote.



Document 2



Document 3

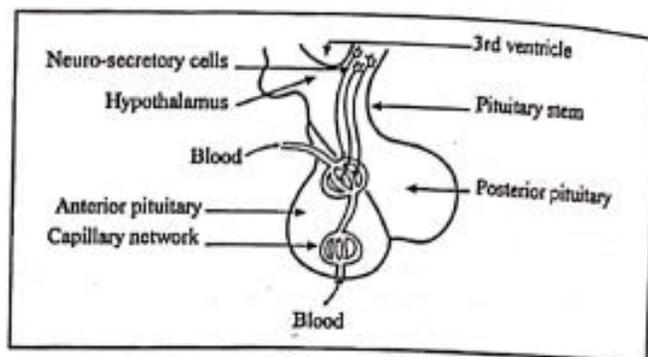
3. 3-1- Name the two principal mechanisms of the sexual reproduction in mammals.
- 3-2- Specify by referring to document 2 the importance of each of these mechanisms.
4. Match each of the schema b, c and d of document 2 with a numbered step of the curve of document 3. Justify the answer.

### Exercise 3:

We aim to study the ovarian and uterine cycles by performing experiments on adult mammals.

Document 1 illustrates the hypothalamo-pituitary complex implicated in the regulation of these cycles.

**Experiment 1:** The ablation of the anterior pituitary is followed by the atrophy of both the ovaries and the uterus along with the disappearance of the cycles.



Document 1

**Experiment 2:** In animals submitted to the ablation of the pituitary gland and receiving regular injections of anterior pituitary extracts, we can observe a redevelopment of the ovaries and sometimes a reestablishment of the ovarian and uterine cycles. However in an ovariectomized animal, injected by anterior pituitary extracts, we never observe a reestablishment of the uterine cycle.

**Experiment 3:** Lesions of the posterior hypothalamus have the same effect as the ablation of the anterior pituitary.

1. Interpret the results of each of the three experiments.

**Experiment 4:** Bilateral ovariectomy provokes a hypertrophy of the pituitary gland followed by an abnormal high production of gonadotropic hormones. This experiment allows us to admit the existence of a feedback mechanism exerted by the ovaries on the production of FSH and LH.

In order to determine the types of this feedback, an ovariectomized female monkey receives, for four periods of 15 days each, injections of ovarian hormones with different doses and composition. For each period the average level of FSH and LH production is measured (document 2).

Periods of 15 days	Characteristics of the injections		Plasmatic levels	
	Composition	Plasmatic levels	of FSH in ng/ml	of LH in ng/ml
1	Estrogen	0	> 15	> 50
	Progesterone	0		
2	Estrogen	70 pg/ml	Around 6	Around 4
	Progesterone	0		
3	Estrogen	300 pg/ml	Around 12	Around 40
	Progesterone	0		
4	Estrogen	300 pg/ml	< 4	< 3
	Progesterone	4 pg/ml		

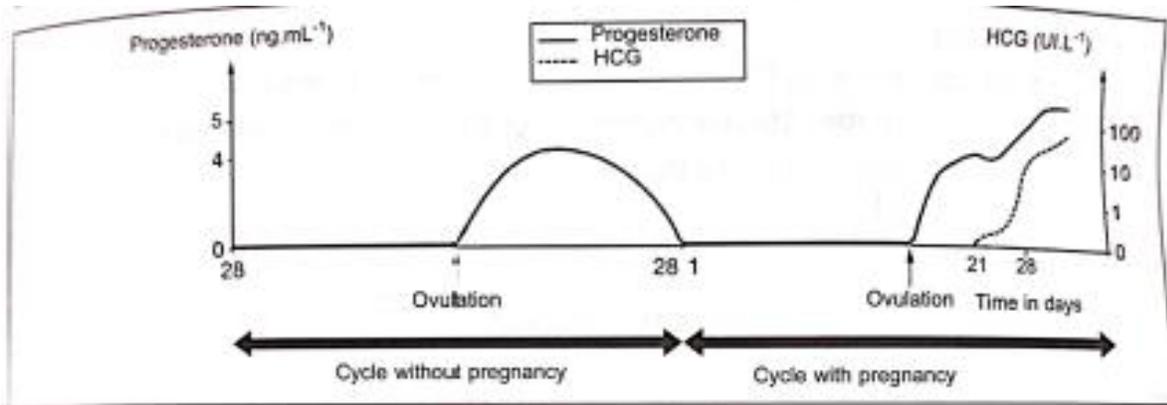
*Document 2*

- State the types of the feedback revealed in document 2. Justify the answer.
- Establish, by referring to the four experiments, a functional diagram showing the relations between the different organs involved in the regulation of the sexual cycles.

**Exercise 4:**

In most mammals the corpus luteum (yellow body), formed after ovulation, has a limited lifespan. In human species, this corpus luteum shrinks after 14 days from its development if fertilization does not occur. However, it persists for a longer time if fertilization and implantation occur. Scientists seek to explain the persistence of corpus luteum for a long time.

Document 1 shows the variation of plasma concentration of progesterone and HCG hormones in a given woman (HCG hormone is a hormone released in the blood of a pregnant woman).



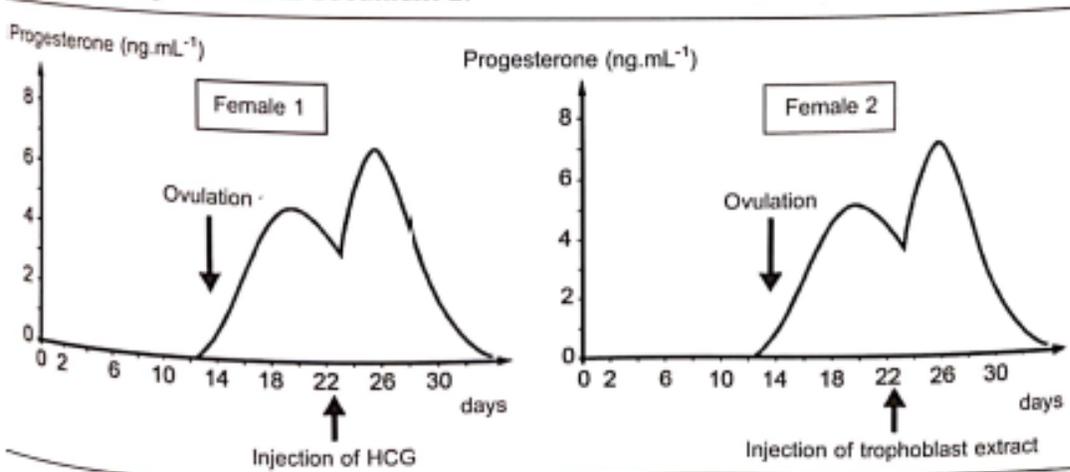
*Document 1*

**D** Show, based on document 1, the cause of the persistence of the corpus luteum.

Two pregnant female macaques (monkeys), whose cycles are comparable to that of a woman, are subjected to different injections:

- Female 1 is injected with HCG;
- Female 2 is injected with ground trophoblast, cells that belong to mammalian embryo.

The variation of progesterone level in these two females is measured. The obtained results are presented in document 2.



Document 2

2 Interpret these results.

Three weeks following fertilization, hormonal dosages are done for both female macaques. The obtained results are presented in document 3.

	Observations	
<b>Lot A</b> Pregnant female macaques.	The plasma concentration of progesterone increases regularly from 5.8 ng.mL <sup>-1</sup> to 9.3 ng.mL <sup>-1</sup>	Maintenance of gestation.
<b>Lot B</b> Pregnant female macaques that receive three injections of anti-HCG antibodies every 24 hour after 18 days of gestation.	Plasma progesterone level decreases from 5 ng.mL <sup>-1</sup> to 1.9 ng.mL <sup>-1</sup>	Spontaneous abortion occurs and menses appears.

Document 3

- 3 Explain, referring to documents 1 and 2 and to the acquired knowledge, the results of document 3.
- 4 Draw a functional diagram that describes the sequence of events that allow the persistence of the corpus luteum necessary for maintaining pregnancy.