

Outcome 1
Class 4 – The Menstrual Cycle
Notes

Table 2 The Female Menstrual Cycle

Phase	Description of events	Hormone produced	Days
flow	• menstruation		1-5
follicular	• follicles develop in ovaries • endometrium is restored	estrogen produced by follicle cells	6-13
ovulation	• oocyte bursts from ovary		14
luteal	• corpus luteum forms and endometrium thickens	estrogen and progesterone produced by the corpus luteum	15-28

- Menstrual cycle in humans takes an average of **28 days**
- Broken into 4 phases:
 - **Flow phase**
 - **Follicular phase**
 - **Ovulatory phase**
 - **Luteal phase**

Flow phase

- Marked by the shedding of the **endometrium**
- Also known as **menstruation**
- Approx 5 days are needed
- During the reproductive years, failure to menstruate may provide the first indication to a woman that she may have become pregnant
- Because of this blood loss, women have higher dietary requirements for iron than do males

Follicular phase

- Follicles develop within the ovary
- Stimulated by **FSH** from the **pituitary**
- Follicles release **estrogen** as they develop
- Estrogen triggers the development of the **endometrial lining**

Ovulatory phase

- By the time the follicle has matured, it has released enough **estrogen** to trigger the pituitary to increase its secretion of **LH** and **FSH**
- LH causes the follicle wall to weaken and the ovum is released (ovulation)
- The ovum is now the largest cell in the body (dia. 0.5mm)
- An unfertilized egg will eventually disintegrate or dissolve in the uterus.

Luteal phase

- After ovulation, the remaining follicle becomes the corpus luteum
- Corpus luteum produces progesterone and estrogen
- These hormones promote the thickening and maintenance of the endometrial lining in preparation for zygote to implant
- If the zygote does not implant and begin to develop into an embryo, the corpus luteum disintegrates after ~14 days
 - progesterone and estrogen levels fall causing menstruation

<http://www.sumanasinc.com/webcontent/animations/content/ovarianuterine.html>

http://msnbcmedia.msn.com/i/msnbc/Components/Interactives/Health/WomensHealth/zFlashAssets/menstrual_cycle_dw2%5B1%5D.swf

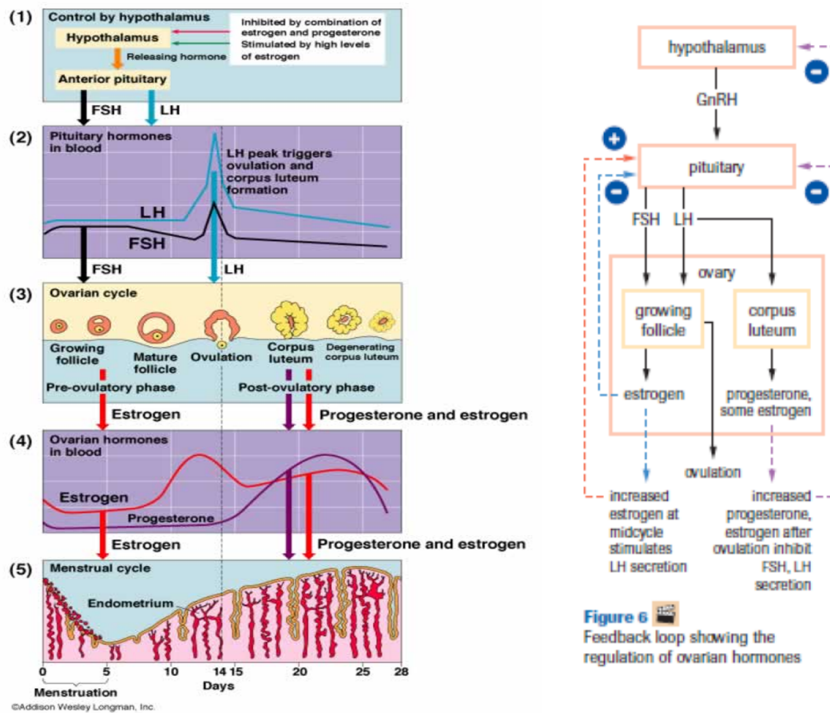
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From Sadava, et al., *Life: The Science of Biology*, Ninth Edition
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Hormonal Control of the Female Reproductive System

- At puberty, the hypothalamus releases GnRH (gonadotropin releasing hormone)
- GnRH stimulates pituitary where FSH and LH are stored
- During the follicular phase of the menstrual cycle, FSH is released and carried by blood to the ovary
 - This stimulates follicle development
 - Developing follicle releases estrogen
 - Estrogen acts on pituitary and decreases FSH release
- Developing follicle produces estrogen
 - High levels of estrogen alone stimulates the hypothalamus, and a spike in LH and FSH is seen.
 - The high levels of LH cause ovulation
- The corpus luteum that forms after ovulation releases estrogen and progesterone
 - The presence of both together inhibits the hypothalamus and FSH and LH levels fall



<http://www.youtube.com/watch?v=WGJsrGmWeKE>

Table 3 Female Reproductive Hormones

Hormone	Location	Description of function
estrogen	follicle cells (ovary)	inhibits growth of facial hair, initiates secondary sexual characteristics, and causes thickening of the endometrium
progesterone	corpus luteum (ovary)	inhibits ovulation, inhibits uterine contractions, firms the cervix, and stimulates the endometrium
follicle-stimulating hormone (FSH)	pituitary	stimulates the development of the follicle cells in the ovary
luteinizing hormone (LH)	pituitary	stimulates ovulation and the formation and maintenance of the corpus luteum

Effects of Estrogen in Women

In females, **breasts** are a manifestation of higher levels of **estrogen**; estrogen also widens the pelvis and increases the amount of body fat in hips, thighs, buttocks, and breasts. Estrogen also induces growth of the **uterus**, proliferation of the **endometrium**, and **menses**.

- Enlargement of **breasts** and erection of **nipples**.^[4]
- Growth of **body hair**, most prominently **underarm** and **pubic hair**
- Greater development of thigh muscles behind the **femur**, rather than in front of it
- Widening of **hips**;^[5] lower **waist to hip ratio** than adult males
- Smaller hands and feet than men
- Elbows that **hyperextend** 5-8° more than men^[6]
- Rounder face
- Smaller waist than men
- Upper arms approximately 2 cm longer, on average, for a given height^[7]
- Changed distribution in weight and fat; more **subcutaneous fat** and **fat** deposits, mainly around the **buttocks**, **thighs**, and **hips**

Use the following information to answer the next four questions.

A series of experiments initially designed to study the effects of fathers' drinking habits on fetal development produced some unexpected results.

Seventy-five male rats were injected with enough alcohol to produce a 0.2% concentration of alcohol in their blood. After 24 hours, these male rats were mated with 75 female rats not treated with alcohol. A control group of 75 untreated male rats were also mated with untreated female rats. Both sets of males copulated normally and with the same vigour.

The pregnancy rate of female rats mated with the alcohol-treated male rats was 50% lower than the pregnancy rate of female rats mated with untreated rats. Also, pup litters in the group with alcohol-treated males appeared to be smaller and individual pups weighed less. Repetition of these experiments produced similar results.

—from *Fackelmann, 1994*

2. Reduction in pregnancy rates for rodent couples in the study group could have been caused by
- A. alcohol-treated males' inability to copulate normally
 - B. alcohol in the female's blood affecting egg production
 - C. alcohol in the male's blood increasing pituitary hormone secretion
 - D. alcohol in the semen fluids producing a poisonous environment for fertilization
3. Prolonged high concentrations of alcohol in the male would likely affect male fertility in all of the following ways **except** by
- A. reducing the rate of meiosis
 - B. preventing the maturation of sperm
 - C. depressing motility in sperm by damaging cells
 - D. stimulating motility in sperm by increasing metabolism

Use the following additional information to answer the next question.

Some Endocrine Glands and Hormones

1	pituitary
2	estrogen
3	testosterone
4	hypothalamus
5	FSH
6	seminal vesicle
7	LH
8	testis

Numerical Response

- 1.** To complete this statement, select the gland or hormone numbered above that best fills each blank.

The production of sperm in the male is directly stimulated by the hormone _____, which is produced in the _____, and by the hormone _____, which is produced in the _____.

Use the following information to answer the next question.

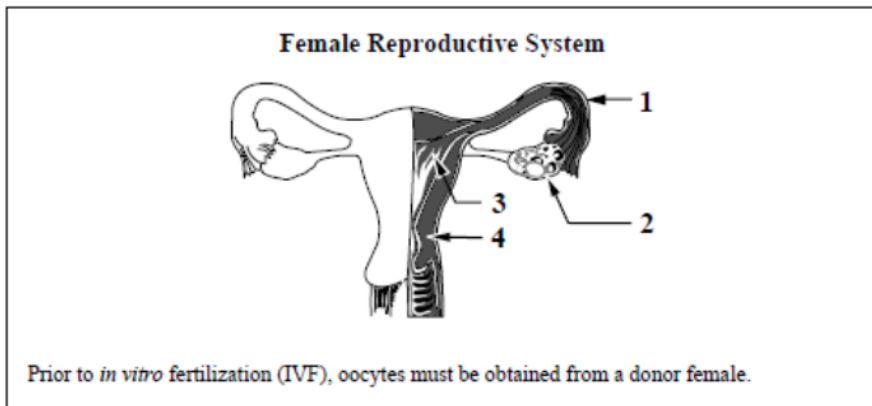
A five-month-old human female fetus produces approximately seven million developing ova (eggs) in her ovaries. Approximately 400 000 of these developing ova survive to puberty. Of these, approximately 400 will complete development and be released during a woman's lifetime.

4. This process is similar to spermatogenesis in males in that
- eggs and sperm are both diploid
 - eggs and sperm are both haploid
 - eggs and sperm are both produced before puberty
 - an equal number of both eggs and sperm reach maturity

In order to initiate *in vitro* fertilization, a woman must undergo hormonal therapy to release numerous mature eggs and to prepare the uterine lining. The eggs are removed using a laparoscope and fertilized in a petri dish. The developing embryos are inserted back into the woman for implantation to take place.

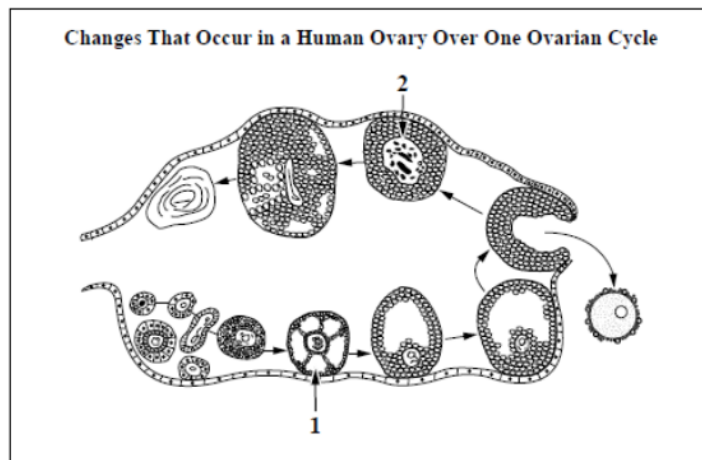
5. What hormone changes would cause a female to develop and release a large number of mature eggs?
- Increased FSH and LH
 - Decreased FSH and LH
 - Increased estrogen and progesterone
 - Decreased estrogen and progesterone

Use the following additional information to answer the next question.



6. To obtain oocytes for *in vitro* fertilization, the structure numbered above that must be hormonally stimulated is
- 1
 - 2
 - 3
 - 4

Use the following additional information to answer the next question.



7. In order for artificial implantation to be successful, what hormone would a female need to take to maintain the uterine lining for implantation, and which of the structures of the ovary numbered above would naturally produce this hormone?
- Estrogen and structure 1
 - Estrogen and structure 2
 - Progesterone and structure 1
 - Progesterone and structure 2

Use the following information to answer the next three questions.

Clomiphene citrate is a fertility drug used to induce ovulation in women. Clomiphene citrate, generally taken daily from day 3 to day 7 of the menstrual cycle, decreases the naturally circulating estrogen. The pituitary responds by increasing production of two gonadotropic hormones that then stimulate the ovary to ripen and release an egg. Follicle development and ovulation are usually monitored with a combination of home urine tests (on day 11 or 12) and a follow-up ultrasound examination. About 70% of women using clomiphene citrate will ovulate and 40% of those will become pregnant. The risk of multiple pregnancy (usually twins) increases by 6% to 7%.

—from Bay Area Fertility and Gynecology Medical Group

8. Without the negative feedback that results from increasing amounts of naturally circulating estrogen, the body responds by secreting more
- FSH
 - HCG
 - prolactin
 - progesterone
9. Following clomiphene citrate treatments, patients are advised to monitor their urine for the presence of a hormone that will signal ovulation. This hormone is
- LH
 - FSH
 - HCG
 - estrogen
10. The incidence of multiple births increases in women who use clomiphene citrate because high levels of
- progesterone may stimulate the release of more than one egg
 - FSH may stimulate the fertilized egg cell to divide and separate
 - FSH may stimulate the complete development of more than one follicle
 - progesterone may stimulate the fertilized egg cell to divide and separate
11. For the processes of spermatogenesis and oogenesis, respectively, the row that identifies the hormone that stimulates the process, the location where the process occurs, and the number of gametes produced per germ cell is

	Spermatogenesis			Oogenesis		
Row	Hormone	Location of process	Number of gametes produced	Hormone	Location of process	Number of gametes produced
A.	FSH	seminiferous tubules	4	FSH	ovaries	1
B.	LH	epididymis	8	LH	pituitary	1
C.	testosterone	interstitial cells	4	estrogen	follicle	4
D.	FSH	testes	8	progesterone	corpus luteum	4

Use the following information to answer the next question.

Responses Stimulated by Hormones

- | | |
|------------------------------------|--|
| 1 Release of thyroxine | 4 Development of follicle and sperm |
| 2 Development of bones and muscles | 5 Ovulation and maintenance of the corpus luteum |
| 3 Water reabsorption by kidneys | 6 Milk production |

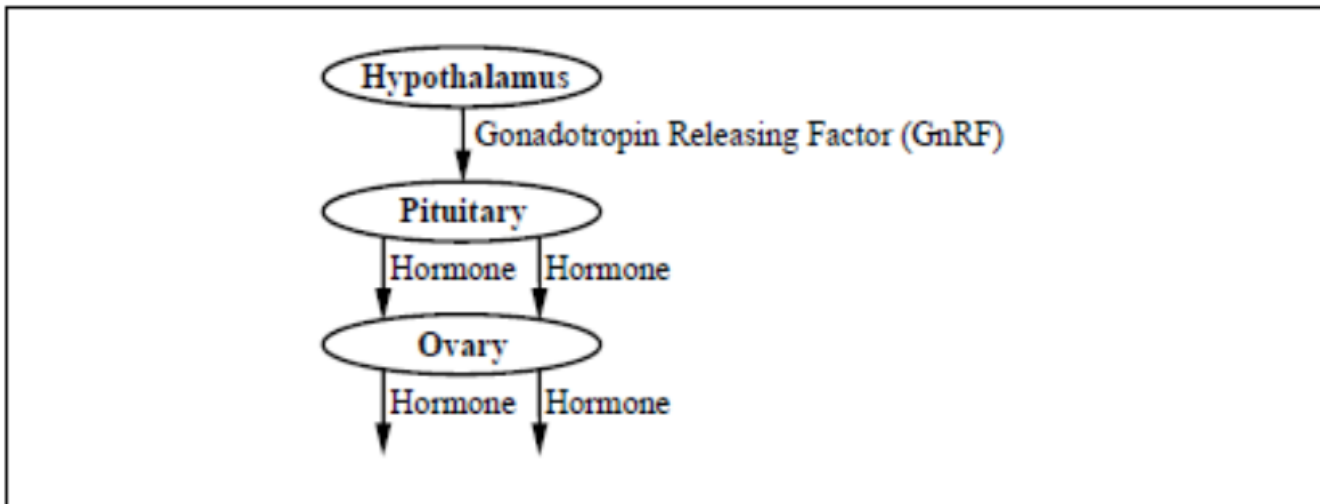
Numerical Response

2. Identify the response, as numbered above, that would be stimulated by each of the hormones given below.

Response: _____
 Hormone: STH(HGH) LH TSH FSH

12. Another contraceptive, the birth control pill, causes negative feedback on the pituitary, which prevents the release of eggs. Typically, the hormones in the birth control pill are similar to
- FSH and LH
 - oxytocin and prolactin
 - estrogen and progesterone
 - relaxin and gonadotropins

Use the following information to answer the next question.



13. In humans, high levels of GnRF cause the pituitary to release
- LH and FSH
 - LH and estrogen
 - progesterone and FSH
 - estrogen and progesterone

Use the following information to answer the next question.

Functions of the Four Main Reproductive Hormones in Human Females

- Stimulation of egg development
- Inhibition of ovulation and uterine contractions
- Stimulation of the development of secondary sex characteristics
- Stimulation of ovulation and formation of the corpus luteum

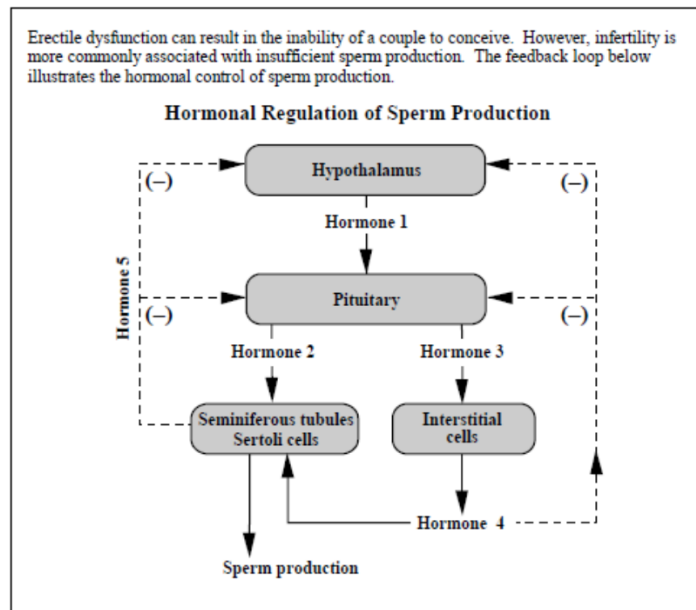
Numerical Response

- 2.** Identify the major function, as numbered above, of each of the hormones given below.

(Record your four-digit answer in the numerical-response section on the answer sheet.)

Function:	_____	_____	_____	_____
Hormone:	FSH	LH	Estrogen	Progesterone

Use the following additional information to answer the next two questions.



14. In the diagram above, the hormones FSH, LH, and testosterone are labelled, respectively,
- 2, 3, 4
 - 2, 3, 5
 - 3, 2, 4
 - 3, 2, 5
15. If infertility were due to decreased production of hormone 1 by the hypothalamus, then fewer sperm would be produced because there would be
- low levels of hormone 2
 - high levels of hormone 3
 - high levels of hormone 4
 - low levels of hormone 5
16. The cells that produce testosterone in females and in males are given in row
- | Row | Females | Males |
|-----|----------------------|---------------------------|
| A. | follicle cells | interstitial cells |
| B. | adrenal cortex cells | interstitial cells |
| C. | follicle cells | seminiferous tubule cells |
| D. | adrenal cortex cells | seminiferous tubule cells |
17. Collectively, the seminal vesicles, prostate gland, and Cowper's glands contribute to which of the following functions?
- Produce testosterone
 - Stimulate spermatogenesis
 - Help sperm survive in the female body
 - Signal the pituitary to release gonadotropins
18. The development of secondary sexual characteristics in the female is due to the secretion of
- LH, followed by the secretion of estrogen
 - LH, followed by the secretion of progesterone
 - FSH and LH, followed by the secretion of estrogen
 - FSH and LH, followed by the secretion of progesterone
19. The hormone that stimulates sex-cell production in both males and females is
- LH
 - FSH
 - testosterone
 - progesterone
20. Which area of the brain regulates male or female reproductive behaviour by directly controlling the release of gonadotropins from the pituitary gland?
- Hypothalamus
 - Pituitary gland
 - Medulla oblongata
 - Frontal lobe of the cerebrum
21. Hormones that stimulate the production of testosterone are transported by the
- blood
 - vas deferens
 - seminiferous tubules
 - ducts from the gland secreting the hormone