تجميع هيكل الاحياء

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تعلیم

1	Explain the structure and function of the male and female human reproductive systems		209

Sperm cells

The male reproductive cells, called sperm cells, are produced in the testes. Follow the path that sperm travel in **Figure 1**, on the previous page, as you read about the structures in the male reproductive system. Sperm, like the one shown in **Figure 2**, develop in the testes in the **seminiferous tubules** (se muh NIHF rus • TEW byulz). These tubules produce 100–200 million sperm each day. Next, sperm travel to the **epididymis** (eh puh DIH duh mus), a structure located on top of each testis where sperm mature and are stored. When the sperm are released from the body, they travel through the **vas deferens** (VAS • DEF uh runz), a duct leading away from the testis. There are two vas deferens, one leading away from each testis. The two vas deferens join together and enter the **urethra** (yoo REE thruh), the tube that carries both semen and urine outside of the body through the penis.

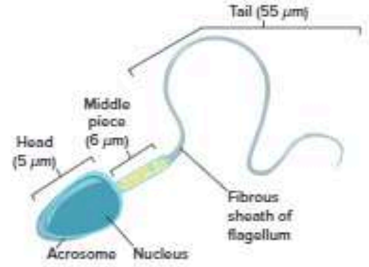


Figure 2 A sperm is a flagellated cell composed of a head, midpiece, and tail.

Identify, *in correct sequence, the structures that a sperm cell passes through or encounters as it makes its way out of the body.*

Sperm require a nourishing fluid to survive long enough to fertilize an egg. **Semen** (SEE mun) refers to the fluid that contains sperm, the nourishment, and other fluids from the male reproductive glands. The seminal vesicles contribute over half of the semen and secrete the sugar needed for energy. They also provide other nutrients, proteins, and enzymes for the sperm. The prostate gland and bulbourethral glands contribute an alkaline solution to the fluid to neutralize acidic conditions that sperm might encounter in the urethra and the female reproductive tract.

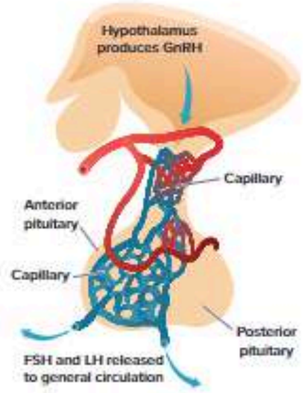
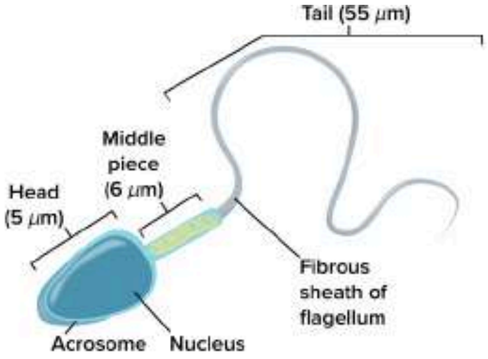


Figure 3 The hypothalamus produces GnRH, which travels to the pituitary gland and influences the rate of LH and FSH production. LH and FSH are regulated by negative feedback.

Male hormones

Testosterone (tes TAHS tuh rohn), a hormone which is made in the testes, is necessary for the production of sperm. It also influences the development of male secondary sex characteristics that begin to appear at **puberty**, the period of growth when sexual maturity is reached. These characteristics include hair on the face and chest, broader shoulders, increased muscle development, and a deeper voice. Three hormones influence testosterone production. **Figure 3** indicates that the hypothalamus produces gonadotropin-releasing hormone (GnRH), which acts on the anterior pituitary gland. GnRH stimulates the production of follicle-stimulating hormone (FSH) and luteinizing (LEW tee uh ni zing) hormone (LH). Both FSH and LH travel from the anterior pituitary gland through the bloodstream and to the testes. In the testes, FSH promotes the production of sperm and LH stimulates the production and secretion of testosterone.



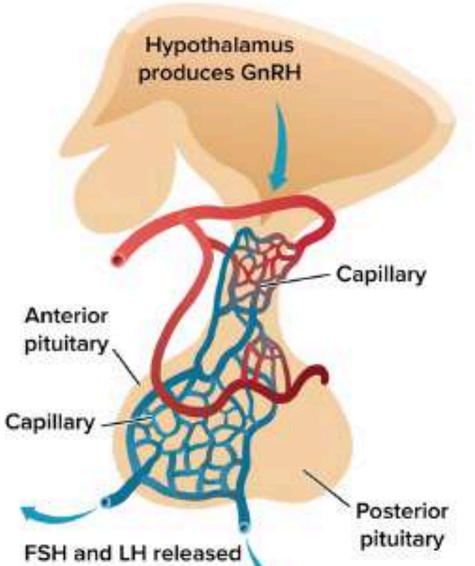
Sperm Cells

- Develop in the testes in the **seminiferous tubules**
- Travel to the **epididymis** and are stored
- Travel through the **vas deferens**
- The two vas deferens join together and enter the **urethra**.
- The male reproductive fluid that contains sperm is called **semen**. It exits the body through the urethra.

- **Testosterone** is a steroid hormone that is necessary for the production of sperm
- It also influences the sex characteristics that appear during **puberty**, the period of growth when sexual maturity is reached.
- Secondary sex characteristics include:
  - Facial and chest hair
  - Broader shoulders
  - Increased muscle development
  - Deeper voice

Three hormones influence testosterone production:

1. Gonadotropin-releasing hormone (GnRH)
2. Follicle-stimulating hormone (FSH)
3. Luteinizing hormone (LH)



تعلیم

1	Explain the structure and function of the male and female human reproductive systems		209

Q1.	Sperm is produced in the _____.
a.	bladder
b.	scortum
c.	testes
d.	ovaries

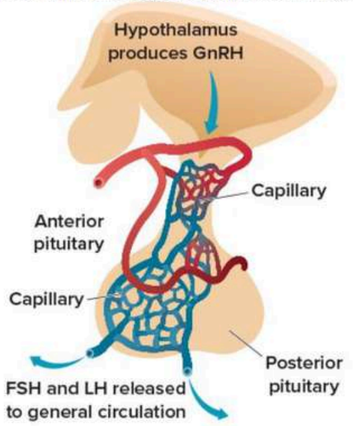
1) Which is a result of the hormone testosterone?

- female pregnancy
- female menstrual cycle
- male sperm production
- male temperature control

Correct Answer

male sperm production

16) What hormone stimulates the gland shown here, in order to regulate testosterone?



- estrogen
- progesterone
- dopamine
- gonadotropin-releasing hormone

Correct Answer

gonadotropin-releasing hormone

4) Both semen and urine are carried outside the body through a tube called th

_____.

Correct Answer

Blank 1: urethra

Which hormones secreted by the anterior pituitary gland regulate the levels of testosterone in males and estrogen in females?

A. follicle-stimulating hormone (FSH)
B. gonadotropin-releasing hormone (GnRH)
C. luteinizing hormone (LH)
D. Both A and C

Which hormone influences the development of male secondary sex characteristics at puberty?

A. follicle-stimulating hormone (FSH)
B. gonadotropin-releasing hormone (GnRH)
C. luteinizing hormone (LH)
D. testosterone

2	Explain how reproductive hormones act in human feedback mechanisms to maintain homeostasis	Table1	212

The Menstrual Cycle

The menstrual cycle typically lasts about 28 days. The entire menstrual cycle can be divided into three phases: the flow phase, the follicular phase, and the luteal phase.

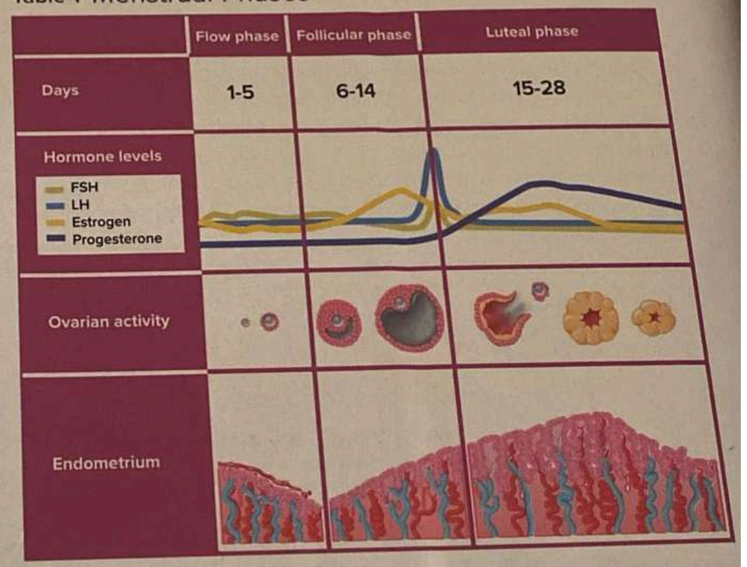
Flow phase

Day one of the menstrual cycle is when menstrual flow begins. Menstrual flow is the shedding of blood, mucus, and epithelial cells from the endometrium—the tissue that lines the uterus. The endometrium is where the embryo implants if fertilization of the egg occurs. Because an embryo needs oxygen and nutrients, the endometrium has a blood supply. During menstruation, bleeding occurs as the outer layers of the endometrium tear away, and blood vessels that supply the endometrium are ruptured. Around day five, repair of the endometrial lining begins. It becomes thicker as the cycle continues.

Follicular phase

During the menstrual cycle, changes also occur in the ovaries as a result of changing hormone levels, as illustrated in **Table 1**. At the beginning of a menstrual cycle, when estrogen levels are low, the anterior pituitary begins to increase production of LH and FSH. This stimulates a few follicles to begin to mature in the ovary. Cells in the follicles then begin to produce estrogen and a small amount of progesterone. Inside each follicle is an immature egg, the oocyte.

Table 1 Menstrual Phases



After about a week, usually only one of the growing follicles remains. This remaining follicle continues to grow and secrete estrogen, which keeps levels of LH and FSH low, an example of negative feedback. On about day 12, the high level of estrogen causes the anterior pituitary gland to release a surge of LH. This rapid release of a large quantity of LH causes the follicle to rupture, and ovulation occurs.

WORD ORIGINS

Female hormones

Estrogen and progesterone (proh JES tuh rohn) are steroid hormones made by cells in the ovaries. A female's anterior pituitary gland also produces LH and FSH. During puberty, an increase in estrogen levels causes a female's breasts to develop, her hips to widen, and her amount of fat tissue to increase. During puberty, a female will also experience her first **menstrual** (MEN stroo ul) **cycle**, the events that take place each month in the human female to help prepare the female body for pregnancy.

Sex Cell Production

Through meiosis, one cell in the testes or ovaries gives rise to four sex cells called gametes. In the human male, sperm are produced daily from primary spermatocytes, beginning at puberty and continuing throughout a male's lifetime.

The production of eggs in the human female differs, as shown in **Figure 5**. A female is born with all of her eggs already beginning to develop. The genetic material has replicated in primary oocytes before birth, and meiosis stops before the first meiotic division is completed. Then, once in each menstrual cycle, meiosis continues for a single developing oocyte. The structures at the end of the first meiotic division of the oocyte are not equal in size. The smaller of the two structures is called a **polar body**, which disintegrates. The second meiotic division takes place only if fertilization occurs. Then, the zygote and the second polar body are formed. The second polar body also disintegrates.

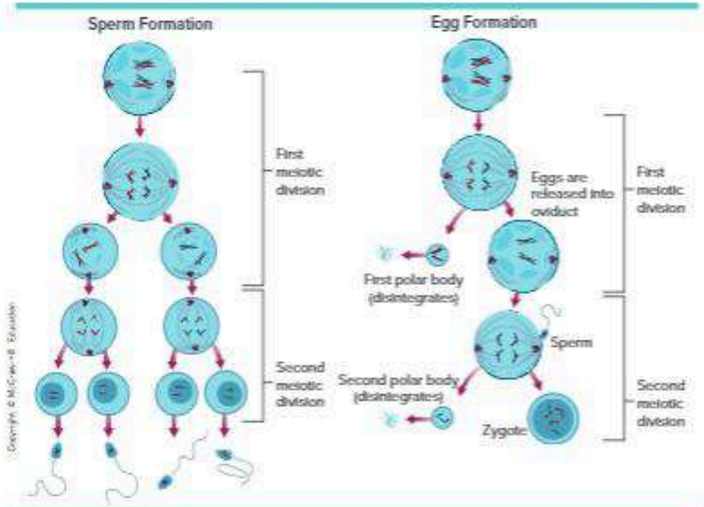


Figure 5 **Left:** The human male sex cell production follows the general pattern of meiosis and results in many sperm. **Right:** Meiosis in the human female results in one egg. The second division in meiosis will not be completed in a human female unless the egg is fertilized.

Estrogen and progesterone are steroid hormones made by cells in the ovaries. The anterior pituitary gland also produces LH and FSH. During puberty, females experience their first **menstrual cycles** and develop secondary sex characteristics influenced by estrogen, including:

- Breast development
- Wider hips
- Fat tissue increase

Through **meiosis**, cells in the testes or ovaries gives rise to sex cells called **gametes**.

- Male gametes are sperm, produced by spermatocytes.
- Female gametes are eggs, produced by oocytes.

Egg production differs from sperm production. Meiosis stops in egg production before the first meiotic division is completed. Once each menstrual cycle, meiosis continues for a single developing oocyte. The smaller of the two structures at the end of the first meiotic division is called a **polar body**, which disintegrates.

3. Which two steroid hormones are produced by the ovaries?

- testosterone and FSH
- estrogen and LH
- B estrogen and progesterone — CORRECT
- progesterone and FSH

17) What results from the first meiotic division of the oocyte?

- sperm formation
- ovulation
- development of a zygote
- development of a polar body

Correct Answer

development of a polar body

The two meiotic divisions of egg production yield how many eggs?

A. one
B. two
C. four
D. six

Q14.	Reproductive cells, which pass on genetic traits from the parents to the child, are produced by the process of _____.
a.	mitosis
b.	meiosis
c.	cytokinesis
d.	cell cycle

Levels of the male hormones are regulated by a negative feedback system that starts with the hypothalamus. Increased levels of testosterone in the blood are detected by cells in the hypothalamus and anterior pituitary, and the production of LH and FSH is decreased. When testosterone levels in the blood drop, the body responds by making more LH and FSH.

Human Female Reproductive System

A female's reproductive system produces egg cells, receives sperm, and provides an environment that is right for fertilization of an egg and the development of an embryo. Refer to **Figure 4** as you read about the structures of the female reproductive system.

Egg cells

Female reproductive cells, called egg cells, are produced in the ovaries, shown in **Figure 4**. Inside each ovary are **oocytes** (OH uh sites), which are immature eggs. Approximately once every 28 days, oocyte development is stimulated and an egg, called an ovum, is formed. The ovum is surrounded by follicle cells that protect and nourish the ovum. After the egg is released from the ovary, it travels through an **oviduct** (OH vuh duct), a tube that connects to the uterus. The uterus, or womb, is where a baby develops before birth. The cervix, at the lower end of the uterus, has a narrow opening into the vagina, which leads to the outside of the female's body.

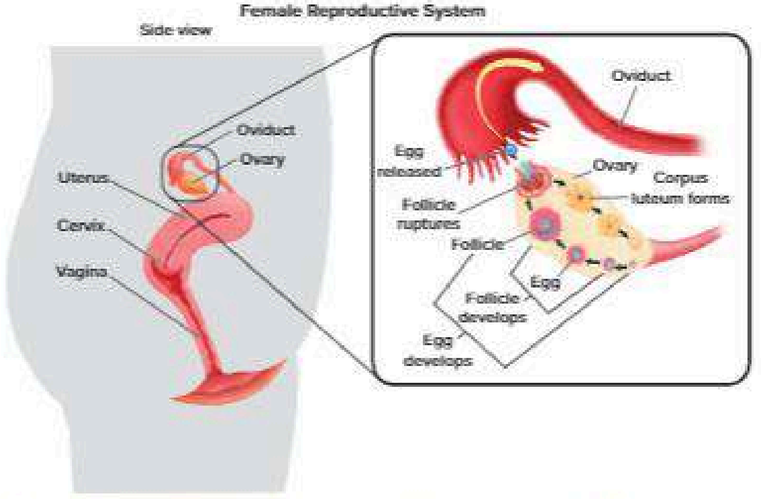
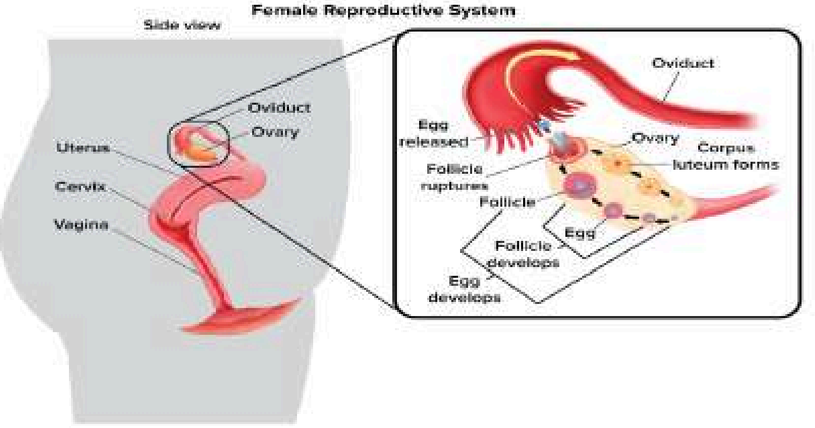


Figure 4 **Left:** The main structures of the female reproductive system are the vagina, uterus, and ovaries. **Right:** During every menstrual cycle, one follicle fully matures and releases an egg. The follicle is then called the corpus luteum.

FEMALE REPRODUCTIVE SYSTEM

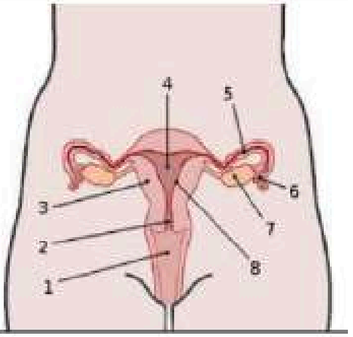
The female reproductive system has three main functions. The first is to produce the female sex cells called egg cells. The second is to receive sperm. The third function is to provide an environment in which a fertilized egg can develop.

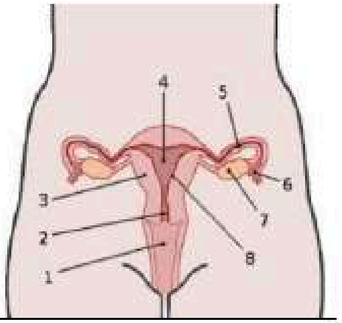


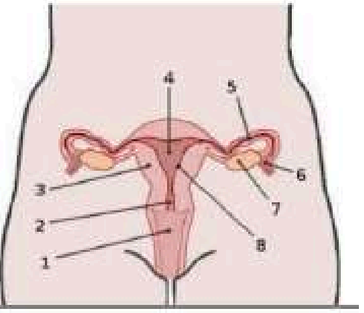
- Egg cells are produced in the ovaries.
- Inside each ovary are **oocytes**, which are immature eggs.
- The egg travels through an **oviduct**, a tube that connects to the uterus.
- The cervix at the lower end of the uterus has a narrow opening into the vagina, which leads to the outside of the female's body.

Where does fertilization occur?

A. in the ovary
B. in the oviduct
C. in the uterus
D. in the cervix

Q4.	Identify the structure labelled number 2. 
a.	cervix
b.	uterus
c.	fallopian tube
d.	ovary

Q5.	Identify the structure labelled number 1. 
a.	cervix
b.	vagina
c.	fallopian tube
d.	ovary

Q3.	Identify the structure labelled number 5. 
a.	cervix
b.	uterus
c.	fallopian tube
d.	ovary

5	Explain the structure and function of the male and female human reproductive systems	Figure1	208

Human Male Reproductive System

Figure 1 illustrates the male reproductive structures. The male reproductive glands are called the testes (tes TEEZ) (singular, testis) and are located outside of the body cavity in a pouch called the scrotum (SKROH tum). A temperature lower than 37°C—the average body temperature—is required for the development of sperm. Because the scrotum is located outside of the body cavity, it is several degrees cooler. This makes the environment suitable for the normal development of sperm.

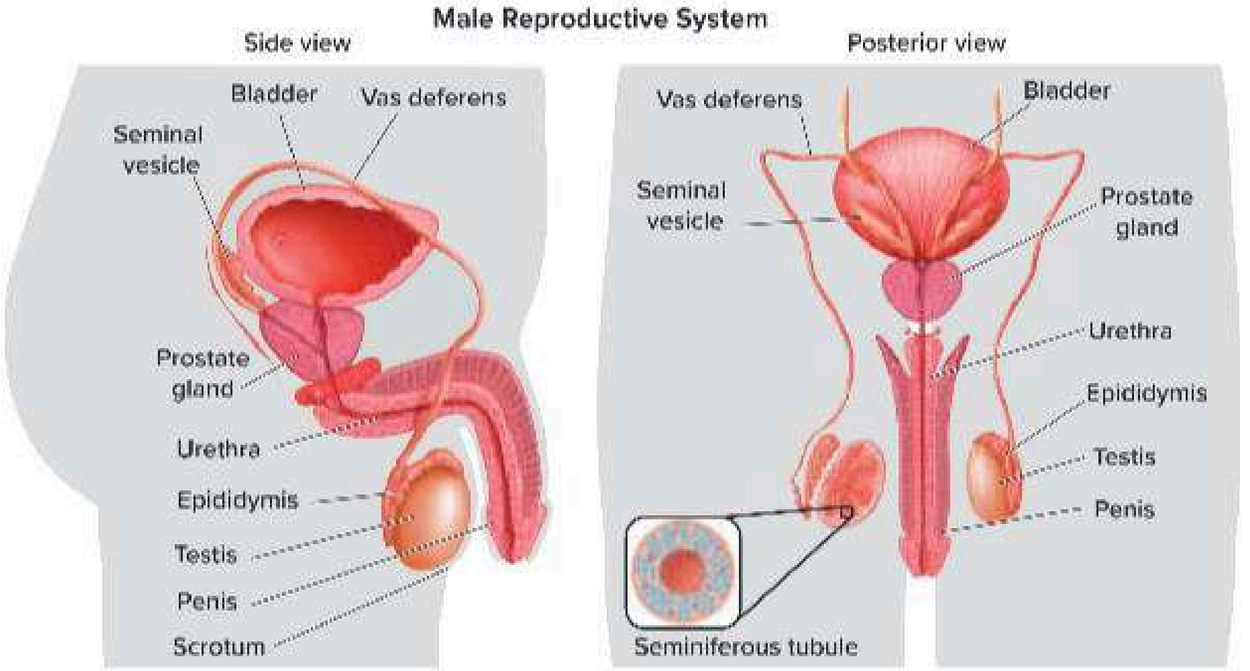


Figure 1 The male reproductive system produces gametes called sperm in the testes.

Male Reproductive System

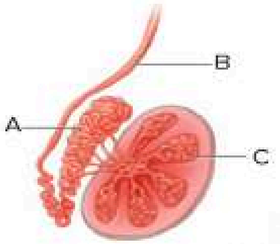
- Reproductive glands are called the testes.
- They are located outside the body cavity in a pouch called the scrotum.
- A temperature lower than 37°C is required for the development of sperm.

5	Explain the structure and function of the male and female human reproductive systems	Figure1	208

1. What would happen if the testes were located inside the body cavity?

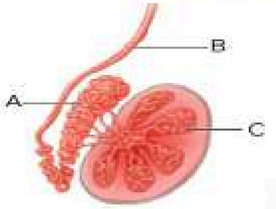
- A. Sperm would not be produced because it is too warm inside the body. CORRECT
- Testosterone levels would increase because of the warm temperature.
- The seminal vesicles would no longer be needed.
- Hormones from the testes would have difficulty entering the bloodstream.

2. What occurs in the structure labeled C?



- sperm cell storage and maturation
- secretion of sugar
- B. sperm cell production CORRECT
- production of FSH

5. What is the function of the structure labeled A in the illustration?



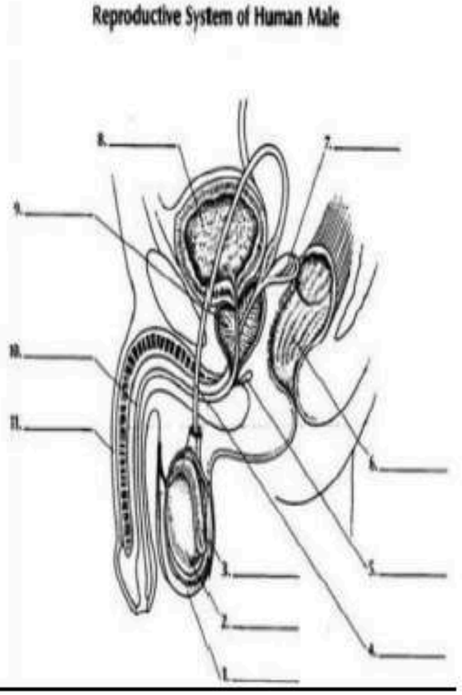
- A. sperm cell storage and maturation CORRECT
- secretion of sugar
- sperm cell production
- production of FSH

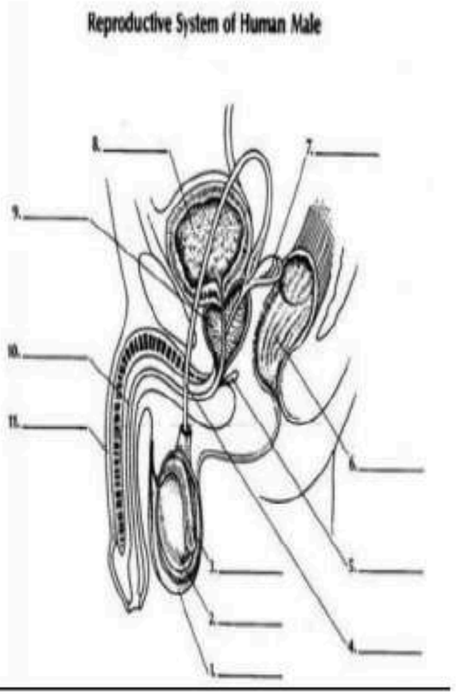
Q13.	Why is the scrotum held outside the body?
a.	to keep the testis cool
b.	to keep the testis warm
c.	for protection
d.	all of the above

What condition is necessary in order for the seminiferous tubules in the testes to produce sperm cells?

A. a slightly acidic environment
B. a temperature lower than 37° C
C. nutritive fluids from the seminal vesicles
D. the release of gonadotropin-releasing hormone (GnRH)

5	Explain the structure and function of the male and female human reproductive systems	Figure1	208

Q9.	Which part of the male reproductive system is labelled number 4? 
a.	penis
b.	sperm duct
c.	urethra
d.	scrotum

Q10.	Which part of the male reproductive system is labelled number 1? 
a.	penis
b.	sperm duct
c.	urethra
d.	scrotum

تعليم

Extraembryonic membranes

The membranes that extend beyond an embryo are called the extraembryonic membranes. You also might have learned about the development of the amniotic egg, and how this enabled animals to reproduce on land. Developing humans have these membranes, as shown in **Figure 9**. But because humans and most other mammals develop inside the mother's body, these membranes have somewhat different functions.

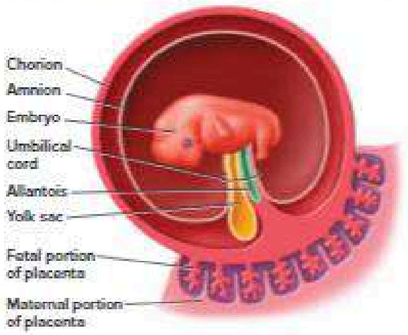


Figure 9 Four extraembryonic membranes—the amnion, chorion, yolk sac, and allantois—are important in development.
Identify *the role of the yolk sac in humans.*

Early in human development, four extraembryonic membranes form. These membranes are the amnion, the chorion (KOR ee ahn), the yolk sac, and the allantois (uh LAN tuh wus), shown in **Figure 9**. The amnion is a thin layer that forms a sac around the embryo. Inside this sac is the **amniotic fluid** (am nee AH tihk • FLU id), which protects, cushions, and insulates the embryo. Outside of the amnion is the chorion, which, together with the allantois, contributes to the formation of the placenta (pluh SEN tuh). The yolk sac in humans does not contain any yolk but serves as the first site of red blood cell formation for the embryo.

The placenta

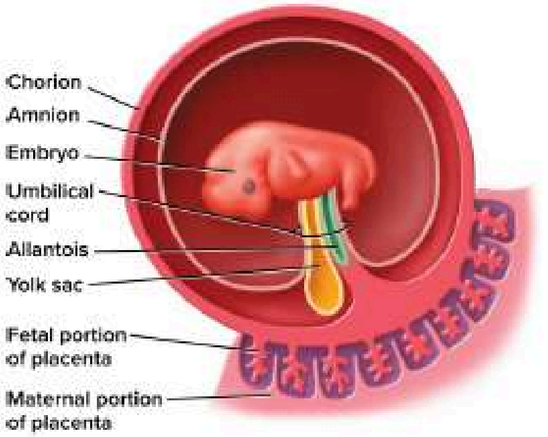
About two weeks after fertilization, tiny fingerlike projections of the chorion, called chorionic villi (VIH li), begin to grow into the wall of the uterus. The placenta, the organ that provides food and oxygen and also removes waste, begins to form. The placenta has two surfaces—a fetal side that forms from the chorion and faces the fetus and a maternal side that forms from uterine tissue. When completely formed, the placenta is 15–20 cm in diameter, 2.5 cm thick, and has a mass of about 0.45 kg. The umbilical cord, a tube containing blood vessels, serves as the connection between the fetus and the mother. **Figure 10**, on the next page, illustrates the connection between the mother and fetus.

The placenta regulates what passes from the mother to the fetus and from the fetus to the mother. Oxygen and nutrients travel from the mother to the fetus. Alcohol, drugs, and the human immunodeficiency virus (HIV) also can pass through the placenta to the developing fetus.

Metabolic waste products and carbon dioxide travel from the fetus to the mother. Because the mother and the fetus have their own separate circulatory systems, blood cells do not pass through the placenta. However, the mother's antibodies pass to the fetus and help protect the newborn until its immune system is functioning.

Four extraembryonic membranes form:

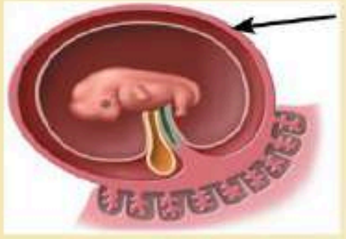
- These membranes are the amnion, the chorion, the yolk sac, and the allantois. The chorion and allantois help form the placenta. Red blood cells form in the yolk sac. The amnion is a thin layer that forms a sac around the developing embryo. Amniotic fluid inside the amnion protects and cushions the embryo. This fluid also helps regulate the embryo's body temperature.



The Placenta

- Provides food and oxygen and removes wastes
- The placenta has two surfaces:
  - A fetal side that forms from the chorion and faces the fetus
  - A maternal side that forms from uterine tissue

What structure is indicated in the image?



A. allantois
B. amnion
C. chorion
D. embryo

What substances *cannot* pass through the placenta between the mother and fetus?

A. alcohol and drugs
B. blood cells and plasma
C. HIV and other viruses
D. metabolic waste products

What is the thin tissue layer that forms a fluid-filled sac around the developing embryo?

A. amnion
B. allantois
C. chorion
D. yolk sac

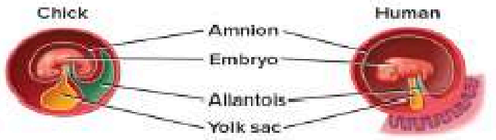
Describe the function of the yolk sac.

A. cushions the embryo
B. nourishes the embryo
C. forms the placenta
D. forms red blood cells



6	Compaire between extraembryonic membranes		216

4. Why is the human yolk sac shown in the illustration smaller than that of the chick?



- The yolk in humans is converted into muscle.
- C Developing humans get their nourishment from the placenta. CORRECT
- The yolk sac in chicks keeps the embryo warm.
- The yolk sac serves no purpose for a developing human.

What do the inner and outer surfaces of the placenta consist of?

- A) amniotic tissue and corpus luteum
- B) chorion and uterine tissue
- C) amniotic tissue and blastocyst
- D) corpus luteum and chorion

Correct Answer

B) chorion and uterine tissue

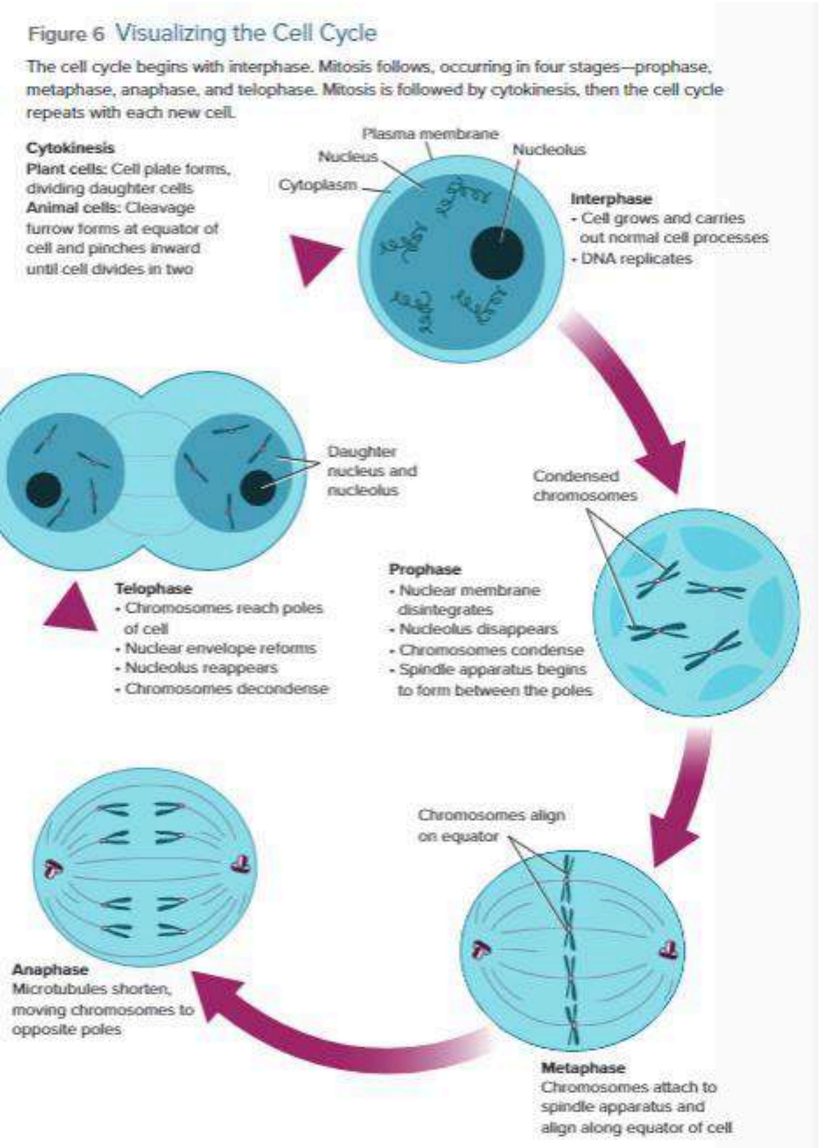
What are the four extraembryonic membranes in fetal development?

- A) acrosome, placenta, plasma membrane, morula
- B) placenta, morula, blastocyst, yolk sac
- C) amnion, chorion, yolk sac, allantois
- D) amnion, yolk sac, acrosome, morula

Correct Answer

C) amnion, chorion, yolk sac, allantois

7	amine specimens under a microscope or similar instrument to identify the various stages of mitosis in plants and anima	Figure6	237



Interphase is divided into three stages: **Gap 1(G_1), synthesis (S), and Gap 2 (G_2).**

1. Gap 1(G_1): growing, carrying out normal cellular functions, and preparing to replicate DNA
2. Synthesis (S): copying DNA to prepare for division
3. Gap 2 (G_2): preparing for the division of nucleus

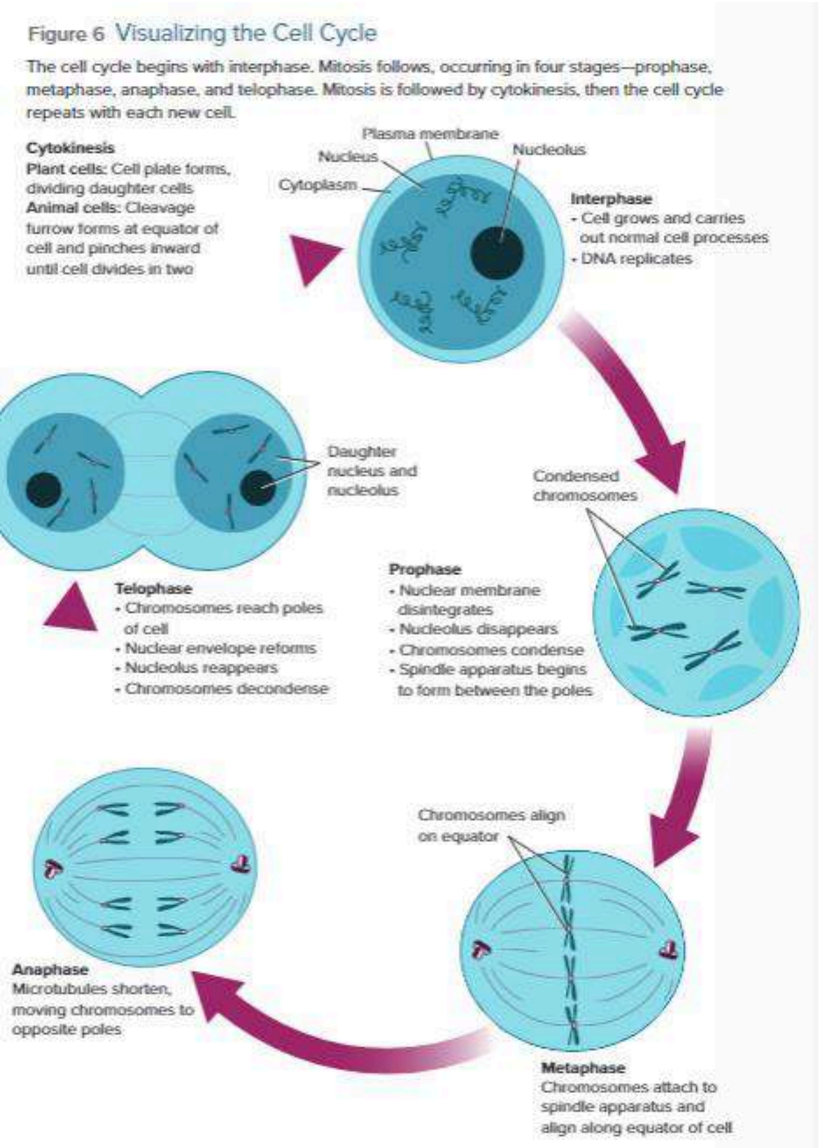
Mitosis

The stage of the cell cycle during which the cell's nucleus and nuclear material divide is called **mitosis**.

1. **Prophase:** the first and longest stage of mitosis Chromatin condenses into chromosomes. **Sister chromatids** are structures that contain identical copies of DNA. They are attached at the **centromere**.
2. **Metaphase:** the second stage of mitosis. Sister chromatids are pulled along the spindle apparatus toward the center of the cell and line up.
3. **Anaphase:** the third stage of mitosis. Chromatids pull apart. Microtubules of the spindle apparatus begin to shorten. Sister chromatids separate. Chromosomes move toward the poles of the cell.
4. **Telophase**: the last stage of mitosis. Chromosomes arrive at poles and begin to relax. Two new nuclear membranes begin to form, and the nucleoli reappear.

Cytokinesis : Towards the end of mitosis, the cell begins **cytokinesis** by which a cell's cytoplasm divides, resulting in two cells with identical nuclei. During cytokinesis in animal cells, microfilaments constrict/pinch off to form two cells. In plant cells, instead of pinching in half, a new structure called the cell plate forms between the two daughter nuclei.

7	amine specimens under a microscope or similar instrument to identify the various stages of mitosis in plants and anima	Figure6	237



Interphase is divided into three stages: **Gap 1(G_1), synthesis (S), and Gap 2 (G_2).**

1. Gap 1(G_1): growing, carrying out normal cellular functions, and preparing to replicate DNA
2. Synthesis (S): copying DNA to prepare for division
3. Gap 2 (G_2): preparing for the division of nucleus

Mitosis

The stage of the cell cycle during which the cell's nucleus and nuclear material divide is called **mitosis**.

1. **Prophase:** the first and longest stage of mitosis Chromatin condenses into chromosomes. **Sister chromatids** are structures that contain identical copies of DNA. They are attached at the **centromere**.
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7	amine specimens under a microscope or similar instrument to identify the various stages of mitosis in plants and anima	Figure6	237

Which occurs in plant cells but not animal cells during the cell cycle?

A. formation of a cell plate
B. formation of microtubules
C. formation of a cleavage furrow at the equator of the cell
D. movement of chromosomes to the poles of the cell

Which diagram shows anaphase?

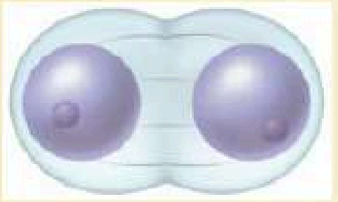
A. 
B. 
C. 
D. 

What happens in the cell during cytokinesis?

A. The cell grows and carries out normal functions.
B. The cell copies its DNA and forms chromosomes.
C. The cell's nucleus and nuclear material divide.
D. The cell's cytoplasm divides.

This cell has completed what stage of mitosis?

A. anaphase
B. interphase
C. metaphase
D. telophase



In what stage of the cell cycle does the cell's replicated genetic material separate?

A. cytokinesis
B. interphase
C. mitosis
D. prophase

During what phase do the sister chromatids line up in the middle of the cell?

A. interphase
B. metaphase
C. anaphase
D. telophase

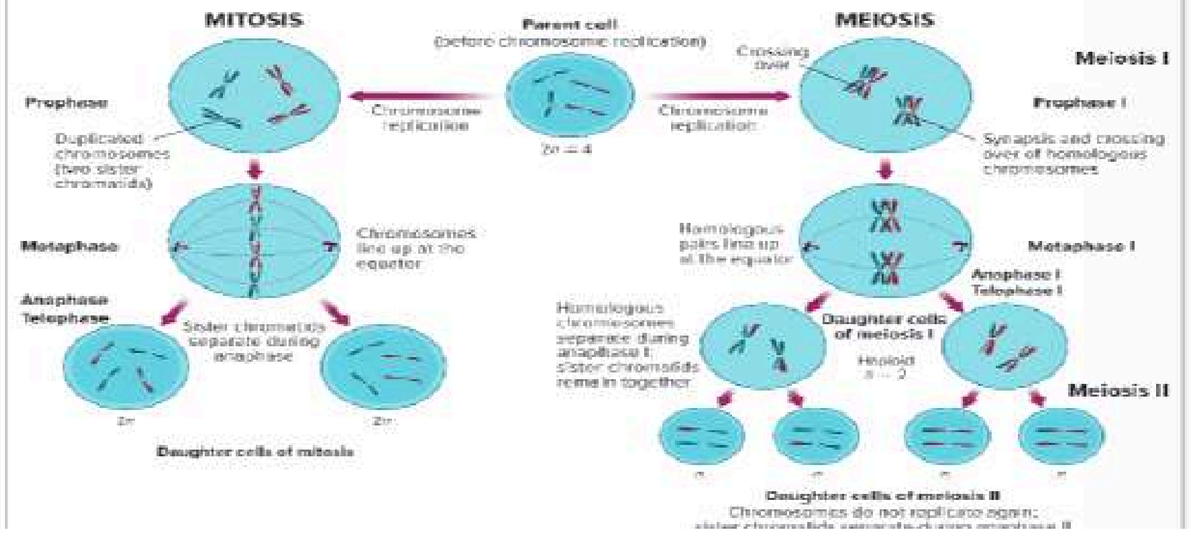
8	Compaire between mitosis and meiosis	Table1	249

The Importance of Meiosis

Table 1 shows a comparison of mitosis and meiosis. Recall that mitosis consists of only one set of division phases and produces two identical diploid daughter cells. Meiosis, however, consists of two sets of divisions and produces four haploid daughter cells that are not identical. Meiosis is important because it results in genetic variation.

Table 1 Mitosis and Meiosis

Mitosis	Meiosis
One division occurs during mitosis.	Two sets of divisions occur during meiosis: meiosis I and meiosis II.
DNA replication occurs during interphase.	DNA replication occurs once before meiosis I.
Synapsis of homologous chromosomes does not occur.	Synapsis of homologous chromosomes occurs during prophase I.
Two identical cells are formed per cell cycle.	Four haploid cells (*n*) are formed per cell cycle.
The daughter cells are genetically identical.	The daughter cells are not genetically identical because of crossing over.
Mitosis occurs only in body cells.	Meiosis occurs only in reproductive cells.
Mitosis is involved in growth and repair.	Meiosis is involved in the production of gametes and providing genetic variation in organisms.



Meiosis Provides Variation

- Depending on how chromosomes line up at the equator, four gametes with four different combinations of chromosomes can result.
- This independent assortment of alleles during gamete formation is a source of genetic variation.

	Mitosis	Meiosis
Number of cell divisions	one	two
Synapsis of homologous chromosomes	does not occur	occurs during prophase I
Products	identical, diploid cells	nonidentical, haploid cells
Type of cells produced	body cells	reproductive cells
Purpose	growth and repair of body tissues	production of gametes for sexual reproduction

8	Compaire between mitosis and meiosis	Table1	249

In what stage of meiosis does genetic variation occur?

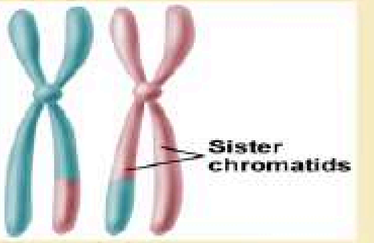
- A) Prophase I
- B) Prophase II
- C) Metaphase I
- D) Metaphase II

Correct Answer

A) Prophase I

Before meiosis I, the sister chromatids of this chromosome were identical. What process caused a change in a section of one chromatid?

A. DNA replication
B. crossing over
C. synapsis
D. telophase



How does the number of chromosomes in gametes compare with the number of chromosomes in body cells?

A. Gametes have 1/4 the number of chromosomes.
B. Gametes have 1/2 the number of chromosomes.
C. Gametes have the same number of chromosomes.
D. Gametes have twice as many chromosomes.

Compared to egg cells formed during meiosis, daughter cells formed during mitosis are

- genetically different, while eggs are genetically identical.
- genetically different, just as egg cells are.
- genetically identical, just as egg cells are.
- genetically identical, while egg cells are genetically different.

تعليم

8	Compaire between mitosis and meiosis	Table1	249

Sperm cells

The male reproductive cells, called sperm cells, are produced in the testes. Follow the path that sperm travel in **Figure 1**, on the previous page, as you read about the structures in the male reproductive system. Sperm, like the one shown in **Figure 2**, develop in the testes in the **seminiferous tubules** (se muh NIHF rus • TEW byulz). These tubules produce 100–200 million sperm each day. Next, sperm travel to the **epididymis** (eh puh DIH duh mus), a structure located on top of each testis where sperm mature and are stored. When the sperm are released from the body, they travel through the **vas deferens** (VAS • DEF uh runz), a duct leading away from the testis. There are two vas deferens, one leading away from each testis. The two vas deferens join together and enter the **urethra** (yoo REE thruh), the tube that carries both semen and urine outside of the body through the penis.

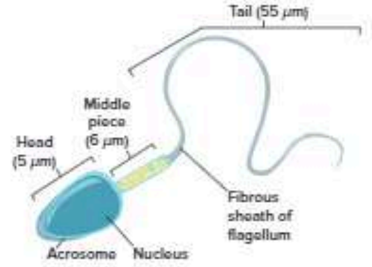


Figure 2 A sperm is a flagellated cell composed of a head, midpiece, and tail.

Identify, *in correct sequence, the structures that a sperm cell passes through or encounters as it makes its way out of the body.*

Sperm require a nourishing fluid to survive long enough to fertilize an egg. **Semen** (SEE mun) refers to the fluid that contains sperm, the nourishment, and other fluids from the male reproductive glands. The seminal vesicles contribute over half of the semen and secrete the sugar needed for energy. They also provide other nutrients, proteins, and enzymes for the sperm. The prostate gland and bulbourethral glands contribute an alkaline solution to the fluid to neutralize acidic conditions that sperm might encounter in the urethra and the female reproductive tract.

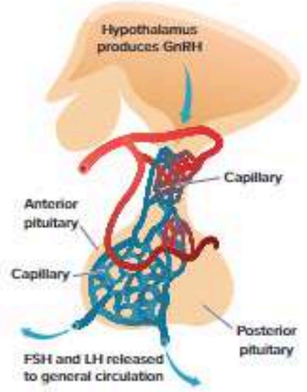
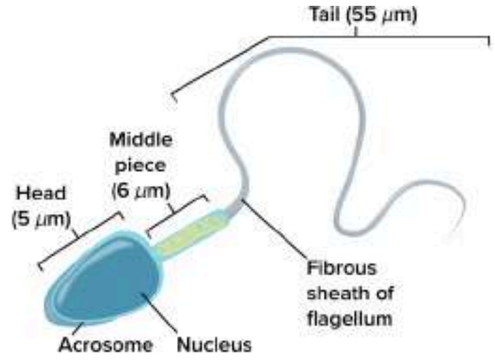


Figure 3 The hypothalamus produces GnRH, which travels to the pituitary gland and influences the rate of LH and FSH production. LH and FSH are regulated by negative feedback.

Male hormones

Testosterone (tes TAHS tuh rohn), a hormone which is made in the testes, is necessary for the production of sperm. It also influences the development of male secondary sex characteristics that begin to appear at **puberty**, the period of growth when sexual maturity is reached. These characteristics include hair on the face and chest, broader shoulders, increased muscle development, and a deeper voice. Three hormones influence testosterone production. **Figure 3** indicates that the hypothalamus produces gonadotropin-releasing hormone (GnRH), which acts on the anterior pituitary gland. GnRH stimulates the production of follicle-stimulating hormone (FSH) and luteinizing (LEW tee uh ni zing) hormone (LH). Both FSH and LH travel from the anterior pituitary gland through the bloodstream and to the testes. In the testes, FSH promotes the production of sperm and LH stimulates the production and secretion of testosterone.



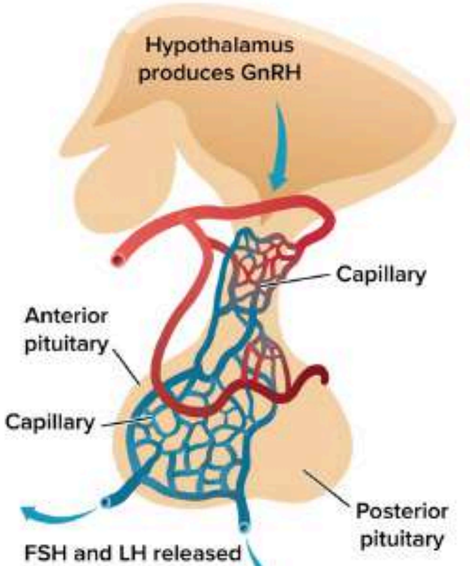
Sperm Cells

- Develop in the testes in the **seminiferous tubules**
- Travel to the **epididymis** and are stored
- Travel through the **vas deferens**
- The two vas deferens join together and enter the **urethra**.
- The male reproductive fluid that contains sperm is called **semen**. It exits the body through the urethra.

- **Testosterone** is a steroid hormone that is necessary for the production of sperm
- It also influences the sex characteristics that appear during **puberty**, the period of growth when sexual maturity is reached.
- Secondary sex characteristics include:
  - Facial and chest hair
  - Broader shoulders
  - Increased muscle development
  - Deeper voice

Three hormones influence testosterone production:

1. Gonadotropin-releasing hormone (GnRH)
2. Follicle-stimulating hormone (FSH)
3. Luteinizing hormone (LH)



تعليم

8	Compaire between mitosis and meiosis	Table1	249

Q1.	Sperm is produced in the _____.
a.	bladder
b.	scortum
c.	testes
d.	ovaries

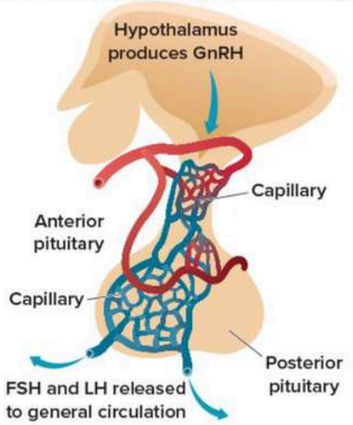
1) Which is a result of the hormone testosterone?

- female pregnancy
- female menstrual cycle
- male sperm production
- male temperature control

Correct Answer

male sperm production

16) What hormone stimulates the gland shown here, in order to regulate testosterone?



- estrogen
- progesterone
- dopamine
- gonadotropin-releasing hormone

Correct Answer

gonadotropin-releasing hormone

4) Both semen and urine are carried outside the body through a tube called th

_____.

Correct Answer

Blank 1: urethra

Which hormones secreted by the anterior pituitary gland regulate the levels of testosterone in males and estrogen in females?

A. follicle-stimulating hormone (FSH)
B. gonadotropin-releasing hormone (GnRH)
C. luteinizing hormone (LH)
D. Both A and C

Which hormone influences the development of male secondary sex characteristics at puberty?

A. follicle-stimulating hormone (FSH)
B. gonadotropin-releasing hormone (GnRH)
C. luteinizing hormone (LH)
D. testosterone

10	Describe how the egg and sperm cells contain only one chromosome of each parent's chromosome pair, and that they unite to form a new individual offspring	Figure7	214

Fertilization

Figure 7 shows fertilization, the process of a sperm joining with an egg. Fertilization usually occurs in the upper portion of an oviduct near the ovary. In humans, both sperm and eggs are haploid, and each normally has 23 chromosomes. Fertilization brings these chromosomes together, restoring the diploid number of 46 chromosomes.

Sperm enter the vagina when strong muscular contractions ejaculate semen from the male's penis during intercourse. Sperm can survive for 48 hours in the female reproductive tract, but an unfertilized egg can survive for only 24 hours. Fertilization can happen if intercourse occurs anytime from a few days before ovulation to a day after ovulation. Overall, there is a relatively short time when fertilization can occur successfully. However, it is important to remember that the length of the menstrual cycle can vary and ovulation can occur at any time.

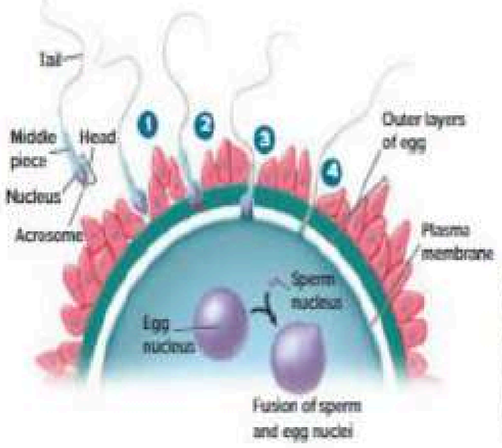
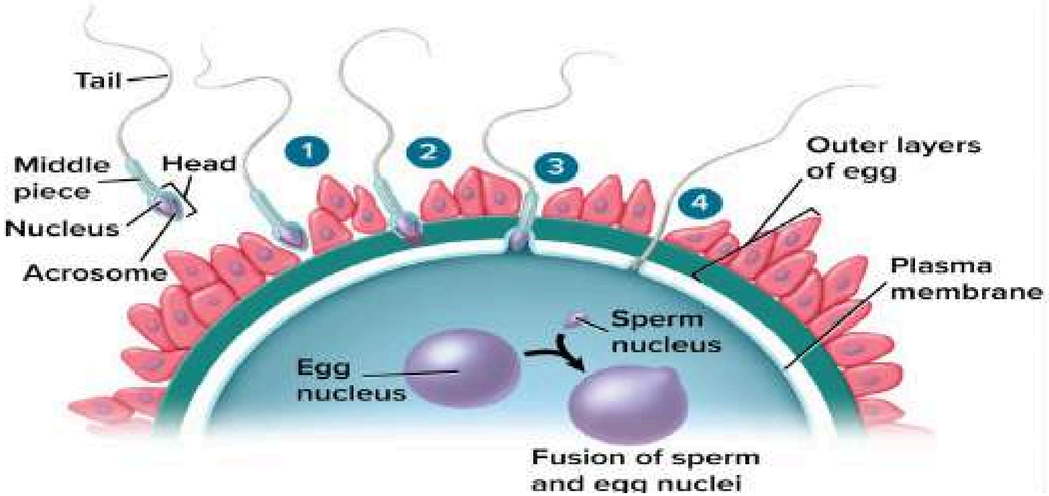


Figure 7 Although many sperm are needed to weaken the barrier that surrounds the egg, only one sperm fertilizes an egg (steps 1-4). Fertilization is complete when the sperm nucleus fuses with the egg nucleus.

Fertilization

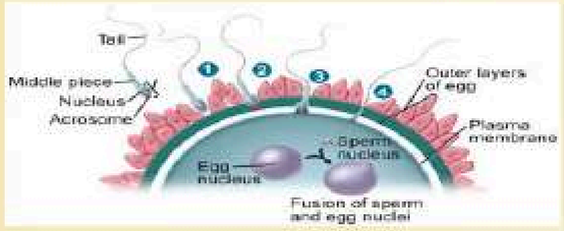
- It is the process of a sperm joining with an egg. Both sperm and eggs are haploid, and each normally has 23 chromosomes.
- Fertilization restores the diploid number (46).
- The tip of each sperm cell is a specialized lysosome called an acrosome that weakens the plasma membrane surrounding the egg.
- Eventually the plasma membrane becomes weak enough that one sperm can penetrate the egg.
- Immediately following this penetration, the egg forms a barrier to prevent other sperm from entering the now-fertilized egg.



10	Describe how the egg and sperm cells contain only one chromosome of each parent's chromosome pair, and that they unite to form a new individual offspring	Figure7	214

What term is used to describe a fertilized egg?

A. blastocyst
B. oocyte
C. polar body
D. zygote



In order for sperm cells to enter a female's reproductive system during intercourse, there must be a strong ejaculation of semen.

A. True
B. False

Why are several hundred sperm cells needed for the fertilization of an egg?

A. They carry hormones to the egg.
B. They contribute DNA to the egg.
C. They help each other swim to the egg.
D. They weaken the egg's plasma membrane.

Q7.	A _____ is formed when fertilization occurs.
a.	embryo
b.	zygote
c.	fetus
d.	sperm

Extraembryonic membranes

The membranes that extend beyond an embryo are called the extraembryonic membranes. You also might have learned about the development of the amniotic egg, and how this enabled animals to reproduce on land. Developing humans have these membranes, as shown in **Figure 9**. But because humans and most other mammals develop inside the mother's body, these membranes have somewhat different functions.

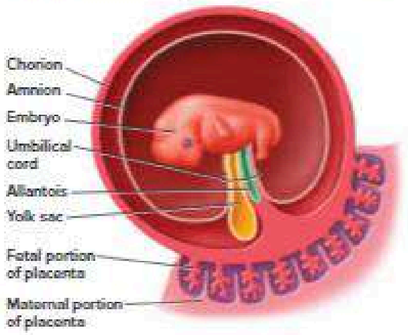


Figure 9 Four extraembryonic membranes—the amnion, chorion, yolk sac, and allantois—are important in development.
Identify *the role of the yolk sac in humans.*

Early in human development, four extraembryonic membranes form. These membranes are the amnion, the chorion (KOR ee ahn), the yolk sac, and the allantois (uh LAN tuh wus), shown in **Figure 9**. The amnion is a thin layer that forms a sac around the embryo. Inside this sac is the **amniotic fluid** (am nee AH tihk • FLU id), which protects, cushions, and insulates the embryo. Outside of the amnion is the chorion, which, together with the allantois, contributes to the formation of the placenta (pluh SEN tuh). The yolk sac in humans does not contain any yolk but serves as the first site of red blood cell formation for the embryo.

The placenta

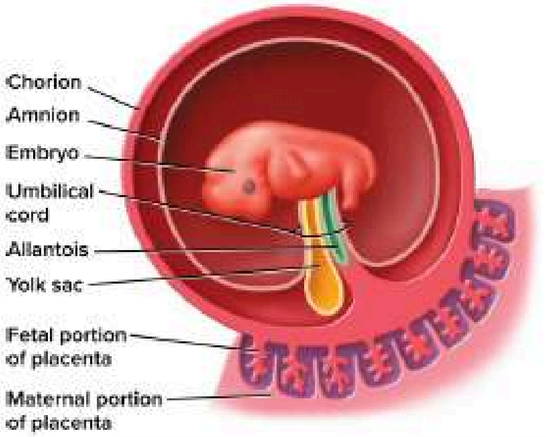
About two weeks after fertilization, tiny fingerlike projections of the chorion, called chorionic villi (VIH li), begin to grow into the wall of the uterus. The placenta, the organ that provides food and oxygen and also removes waste, begins to form. The placenta has two surfaces—a fetal side that forms from the chorion and faces the fetus and a maternal side that forms from uterine tissue. When completely formed, the placenta is 15–20 cm in diameter, 2.5 cm thick, and has a mass of about 0.45 kg. The umbilical cord, a tube containing blood vessels, serves as the connection between the fetus and the mother. **Figure 10**, on the next page, illustrates the connection between the mother and fetus.

The placenta regulates what passes from the mother to the fetus and from the fetus to the mother. Oxygen and nutrients travel from the mother to the fetus. Alcohol, drugs, and the human immunodeficiency virus (HIV) also can pass through the placenta to the developing fetus.

Metabolic waste products and carbon dioxide travel from the fetus to the mother. Because the mother and the fetus have their own separate circulatory systems, blood cells do not pass through the placenta. However, the mother's antibodies pass to the fetus and help protect the newborn until its immune system is functioning.

Four extraembryonic membranes form:

- These membranes are the amnion, the chorion, the yolk sac, and the allantois. The chorion and allantois help form the placenta. Red blood cells form in the yolk sac. The amnion is a thin layer that forms a sac around the developing embryo. Amniotic fluid inside the amnion protects and cushions the embryo. This fluid also helps regulate the embryo's body temperature.



The Placenta

- Provides food and oxygen and removes wastes
- The placenta has two surfaces:
  - A fetal side that forms from the chorion and faces the fetus
  - A maternal side that forms from uterine tissue

11	Compaire between extraembryonic membranes	Figure9	216

What structure is indicated in the image?



A. allantois
B. amnion
C. chorion
D. embryo

What substances *cannot* pass through the placenta between the mother and fetus?

A. alcohol and drugs
B. blood cells and plasma
C. HIV and other viruses
D. metabolic waste products

What is the thin tissue layer that forms a fluid-filled sac around the developing embryo?

A. amnion
B. allantois
C. chorion
D. yolk sac

Describe the function of the yolk sac.

A. cushions the embryo
B. nourishes the embryo
C. forms the placenta
D. forms red blood cells



12	Compare between cell cycle regulation		241

Apoptosis

Not every cell is destined to survive. Some cells go through a process called **apoptosis** (a pup TOH sus), or programmed cell death. Cells going through apoptosis actually shrink and shrivel in a controlled process. All animal cells appear to have a "death program" that can be activated. One example of apoptosis occurs during the development of the human hand and foot. When the hands and feet begin to develop, cells occupy the spaces between the fingers and toes. Normally, this tissue undergoes apoptosis, with the cells shriveling and dying at the appropriate time so that the webbing is not present in the mature organism.

An example of apoptosis in plants is the localized death of cells that results in leaves falling from trees during autumn. Apoptosis also occurs in cells that are damaged beyond repair, including cells with DNA damage that could lead to cancer. Apoptosis can help to protect organisms from developing cancerous growths.

Abnormal cell cycle: cancer

When cells do not respond to the normal cell cycle control mechanisms, a condition called cancer can result. **Cancer** is the uncontrolled growth and division of cells—a failure in the regulation of the cell cycle. When unchecked, cancer cells can kill an organism by crowding out normal cells, resulting in the loss of tissue function. Cancer cells spend less time in interphase than do normal cells, which means cancer cells grow and divide unrestrained as long as they are supplied with essential nutrients. **Figure 12** shows how cancer cells can intrude on normal cells.

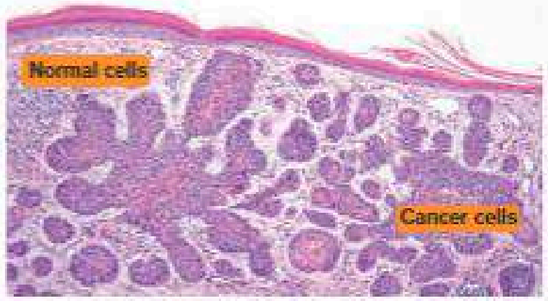


Figure 12 Cancer cells often have an abnormal, irregular shape compared to normal cells. In this image some cancer cells are entering vessels, which might carry them to another part of the body. This is one way cancer can spread from one body part to another.

Causes of cancer Cancer does not just occur in a weak organism. In fact, cancer occurs in many healthy, active, and young organisms. The changes that occur in the regulation of cell growth and division of cancer cells are due to mutations or changes in the segments of DNA that control the production of proteins, including proteins that regulate the cell cycle. Often, the genetic change or damage that occurs is repaired. But if the repair systems fail, cancer can result. Various environmental factors can affect the occurrence of cancer cells. Substances and agents that are known to cause cancer are called **carcinogens** (kar SIHnuh junz).

Apoptosis

- Not every cell is destined to survive. Some cells go through **apoptosis**, or programmed cell death.
- These cells shrink or shrivel in a controlled process.
- An example of apoptosis occurs in the development of the human hand and foot. Cells in spaces between fingers and toes undergo apoptosis.
- An example in plants is the localized death of cells that results in leaves falling from trees during autumn.

Abnormal Cell Cycle: Cancer

- **Cancer** is the uncontrolled growth and division of cells. Cancer results when cells stop responding to the controls of the cell cycle.
- Cancer cells can kill an organism by crowding out normal cells, resulting in loss of tissue function.

Causes of Cancer

- Mutations cause cancer cell growth and division.
- Environmental factors can affect the occurrence of cancer cells.
- **Carcinogens** are substances or agents known to cause cancer.
- Not all cancers can be prevented, but avoiding known carcinogens can help reduce the risk.

Cancer Genetics

- More than one change in DNA is required to change an abnormal cell into a cancer cell.
- This might explain why risk increases with age.

12	Compare between cell cycle regulation		241

Q14.	When it occurs at the proper time, programmed cell death (apoptosis)
a.	will disrupt homeostasis
b.	may cause defective genetic info to be passed to the next generation of cells
c.	is an important regulatory process that maintains the health of a multicellular organism
d.	can contribute to the development of cancer

Q11.	Which phrase best describes a common characteristic of all cancers?
a.	absence of cyclins
b.	damaged DNA
c.	uncontrolled cell growth
d.	inherited from parents

Q13.	Which of these is a risk factor for developing cancer? CHECK ALL THAT APPLY
a.	growing older
b.	genetic inheritance
c.	exposure to carcinogens (toxins that can damage DNA)
d.	smoking

Which is *not* a condition that can result in cancer?

A. a failure in the control mechanisms that regulate the cell cycle

B. a failure in the repair systems that fix changes or damage to DNA

C. a failure of the spindle fibers to move chromosomes during mitosis

D. mutations or changes in segments of DNA that control protein production

12	Compare between cell cycle regulation		241

What is the term for the programmed death of cells that are damaged beyond repair or have harmful changes in their DNA?

A. apoptosis
B. carcinogens
C. cytokinesis
D. mitosis

Which of these cancer-causing substances or agents is impossible to avoid completely?

A. chemicals such as asbestos
B. food and drinks that the FDA warns may contain carcinogens
C. tobacco and second-hand smoke
D. ultraviolet radiation from the Sun

What term is used to describe programmed cell death?

A. apoptosis
B. anaphase
C. necrosis
D. cyclins

13	Compare between three trimesters of development	Figure11	218

Hormonal regulation during pregnancy

During the first week of development, the embryo begins to secrete a hormone called human chorionic gonadotropin (hCG), which keeps the corpus luteum intact. If the corpus luteum remains active, progesterone levels, and to a lesser extent estrogen levels, remain high. When levels of these hormones remain high, a new menstrual cycle does not begin. Two to three months into development, the placenta secretes enough progesterone and estrogen to maintain the proper conditions for pregnancy.

Three Trimesters of Development

Human development takes about 266 days from fertilization to birth. This time span is divided into three trimesters, each around three months long. During this time, the zygote grows from a single cell into a baby that has trillions of cells that develop into tissues and organs.

The first trimester

In the first trimester, all tissues, organs, and organ systems begin to develop. Figure 11 shows stages of development during the first trimester. During the first two weeks of development, the mother might not realize that she is pregnant and exposure to certain substances or a lack of certain essential nutrients might cause irreversible damage to the developing embryo. A few of the major causes of preventable birth defects are listed in Table 2 on the next page.





EARLY DEVELOPMENT

As an embryo develops, the chorionic villi begin to grow into the uterine wall Nutrients, oxygen, and wastes diffuse across maternal and fetal blood vessels and are carried to and from the fetus through the umbilical cord. The placenta contains tissue from both mother and fetus.

During the first week of development, the embryo begins to secrete human chorionic gonadotropin (hCG). This keeps the corpus luteum intact, keeping progesterone and estrogen levels higher. When these hormones are at high levels, a new menstrual cycle does not begin. At two to three months development, the placenta secretes enough progesterone and estrogen to maintain the conditions for pregnancy.

13	Compare between three trimesters of development	Figure11	218

3. Which is produced by the placenta?

- ~~human chorionic gonadotropin~~
- ~~oxytocin~~
- B estrogen and progesterone — CORRECT
- ~~endometrial birth hormone~~

What prevents the menstrual cycle from continuing once an egg has been fertilized?

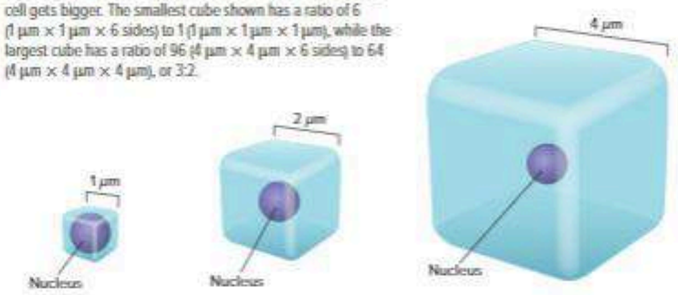
A. Progesterone levels remain high.
B. Estrogen levels decrease.
C. The corpus luteum degenerates.
D. Blood supply to the endometrium decreases.

Q2.	A fertilized egg develops in the _____.
a.	cervix
b.	uterus
c.	vagina
d.	ovary

Q15.	Determine the stage of development from the image on the right. 
a.	4 weeks
b.	5-6 weeks
c.	7-8 weeks
d.	9-10 weeks

14	Describe and calculate the ratio of surface area to volume	Figure1	233

Figure 1 The ratio of surface area to volume decreases as a cell gets bigger. The smallest cube shown has a ratio of 6 (1 µm × 1 µm × 6 sides) to 1 (1 µm × 1 µm × 1 µm), while the largest cube has a ratio of 96 (4 µm × 4 µm × 6 sides) to 64 (4 µm × 4 µm × 4 µm), or 3:2.



If the cubic cell grows to 2 µm per side, as represented in **Figure 1**, the surface area becomes 24 µm² and the volume is 8 µm³. The ratio of surface area to volume is now 3:1, which is less than it was when the cell was smaller. If the cell continues to grow, the ratio of surface area to volume will continue to decrease, as shown by the third cube in **Figure 1**. As the cell grows, its volume increases much more rapidly than the surface area. This means that the cell might have difficulty supplying nutrients and expelling enough waste products. By remaining small, cells have a higher ratio of surface area to volume and can sustain themselves more easily.

Get It?
Explain why a high ratio of surface area to volume benefits a cell.

Transport of substances Another task that can be managed more easily in a small cell than in a large cell is the movement of substances. Recall that the plasma membrane controls cellular transport because it is selectively permeable. Once inside the cell, substances move by diffusion or by motor proteins pulling them along the cytoskeleton.

Diffusion over large distances is slow and inefficient because it relies on random movement of molecules and ions. Similarly, the cytoskeleton transportation network, shown in **Figure 2**, becomes less efficient for a cell if the distance to travel becomes too large. Small cell size maximizes the ability of diffusion and motor proteins to transport nutrients and waste products. Small cells maintain more efficient transport systems.

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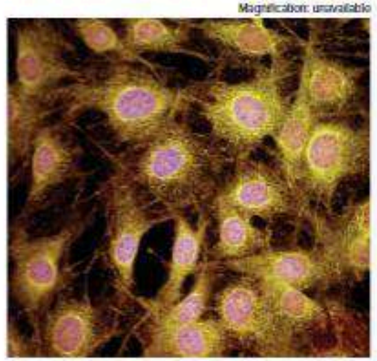


Figure 2 In order for the cytoskeleton to be an efficient transportation railway, the distances that substances have to travel within a cell must be limited.

Ratio of Surface Area to Volume

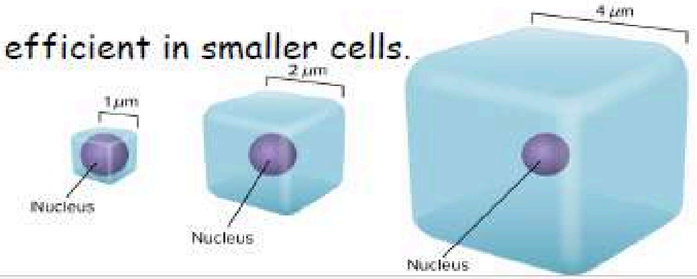
- Several factors influence cell size.
- Surface area is the area covered by the plasma membrane.
- The plasma membrane is the structure through which all the nutrients and waste products must pass.
- Volume is the space taken up by the inner contents of the cell.
- The ratio of surface area to volume decreases as a cell gets bigger.
- Cells with a higher ratio of surface area to volume can sustain themselves more easily.

Transport of Substances

- Smaller cells can transport substances more easily.
- Diffusion is inefficient over longer distances.
- The cytoskeleton transportation network becomes less efficient for a cell if the distance to travel becomes too large.

Cellular Communication

- Cellular communication is more efficient in smaller cells.



14	Describe and calculate the ratio of surface area to volume	Figure1	233

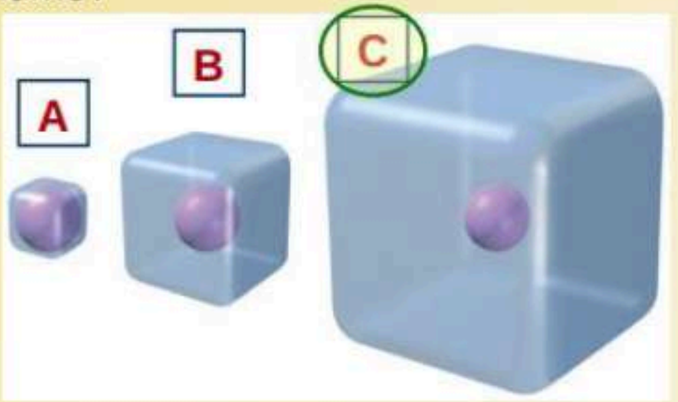
1. Which is a reason why cells remain small?

- Large cells have difficulty diffusing nutrients rapidly enough.
- As cells grow, their ratio of surface area to volume decreases.
- Transportation of wastes becomes a problem for large cells.
- D All of the above. CORRECT

Which can more efficiently supply nutrients and expel waste products?

A. larger cells
B. smaller cells
C. cells with lower surface area to volume ratio
D. cells shaped like a cube

Which cell has the lowest ratio of surface area to volume?



15	Conclude that the processes of the cell cycle and mitosis, through which cells grow and divide, allow organisms to grow	Figure4	235

The Cell Cycle

Cells reproduce by a cycle of growing and dividing called the **cell cycle**. Cellular reproduction allows your body to grow and heal certain injuries. Each time a cell goes through one complete cell cycle, it becomes two cells. The duration of the cell cycle varies. Some eukaryotic cells might complete the cycle in as few as eight minutes, while other cells might take up to one year. For most normal, actively dividing animal cells, the cell cycle takes about 12–24 hours. There are three main stages of the cell cycle.

Interphase

Interphase is the stage during which the cell grows, develops into a mature, functioning cell, duplicates the DNA in its nucleus, and prepares for division. Interphase is divided into three stages as shown in **Figure 4**: G_1, S, and G_2, also called Gap 1, synthesis, and Gap 2. When these activities are completed, the cell begins mitosis.

Gap 1 (G_1) The first stage of interphase, G_1, is the period immediately after a cell divides. During G_1, a cell is growing, carrying out normal cell functions, and preparing to replicate DNA. Some cells, such as muscle and nerve cells, exit the cell cycle at this point and do not divide again.

Synthesis (S) The second stage of interphase, S, is the period when a cell copies its DNA in preparation for cell division.

Gap 2 (G_2) The G_2 stage follows the S stage and is the period when the cell prepares for the division of its nucleus. A protein that makes microtubules for cell division is synthesized at this time. During G_2, the cell also takes inventory and makes sure it is ready to continue with mitosis.

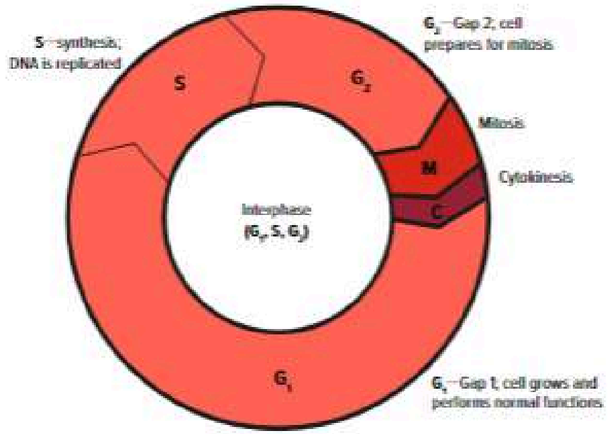


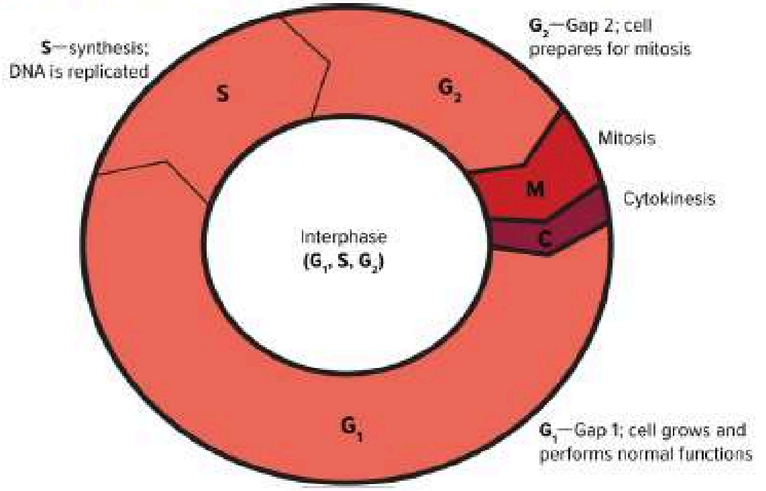
Figure 4 The cell cycle involves three stages—interphase, mitosis, and cytokinesis. Interphase is divided into three substages.

Cells reproduce by a cycle of growing and dividing called the **cell cycle**.

Interphase

Interphase is the stage during which the cell grows, develops into a mature, functional cell, duplicates the DNA in its nucleus, and prepares for division. Interphase is divided into three stages: **Gap 1(G_1), synthesis (S), and Gap 2 (G_2)**.

1. Gap 1(G_1): growing, carrying out normal cellular functions, and preparing to replicate DNA
2. Synthesis (S): copying DNA to prepare for division
3. Gap 2 (G_2): preparing for the division of nucleus



15	Conclude that the processes of the cell cycle and mitosis, through which cells grow and divide, allow organisms to grow	Figure4	235

2. Which describes the activities of a cell that include cellular growth and cell division?

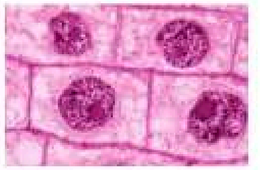
A cell cycle
CORRECT

mitosis

chromatin

cytoplasm

Q5.	In the S stage of interphase_____
a.	the cell grows
b.	the nucleus divides
c.	the cell membrane divides
d.	the DNA is replicated

Q9.	Name the phase that all of these cells are in. Hint: Cells spend most of their time in this phase preparing to divide. 
a.	prophase
b.	anaphase
c.	interphase
d.	metaphase

Which of the following stages of interphase shows the cell growing, carrying out normal cell functions, and preparing to replicate DNA?

- A) Gap 1 (G_1)
- B) Synthesis (S)
- C) Gap 2 (G_2)
- D) Cytokinesis

Correct Answer

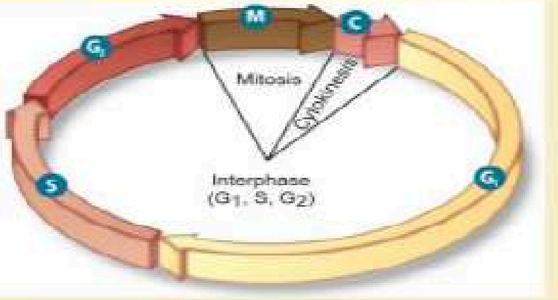
A) Gap 1 (G_1)

15	Conclude that the processes of the cell cycle and mitosis, through which cells grow and divide, allow organisms to grow	Figure4	235

Q12.	In which stage of the cell cycle are cells most susceptible (likely to experience) to mutations?
a.	G1
b.	S
c.	G2
d.	G0

At what stage of interphase does the cell take inventory and make sure it is ready for the division of its nucleus?

A. G_1
B. S
C. G_2
D. M



Which is *not* a phase of the cell cycle?

A. cytokinesis
B. interphase
C. apoptosis
D. mitosis

At what stage does a cell spend most of its life?

A. cytokinesis
B. interphase
C. mitosis
D. synthesis

16	Describe how the egg and sperm cells contain only one chromosome of each parent's chromosome pair		234

Cellular communication The need for signaling proteins to move throughout the cell also limits cell size. In other words, cell size affects the ability of the cell to communicate instructions for cellular functions. If the cell becomes too large, it becomes almost impossible for cellular communications, many of which involve movement of substances and signals to various organelles, to take place efficiently. For example, the signals that trigger protein synthesis might not reach the ribosome fast enough for protein synthesis to occur to sustain the cell.

Chromosomes

If a DNA strand 140 million nucleotides long was laid out in a straight line, it would be about five centimeters long. How does all of this DNA fit into a microscopic cell? In prokaryotes, the DNA molecule is contained in the cytoplasm and consists mainly of a ring of DNA and associated proteins. In eukaryotes, the DNA strand is wound up in a tight coil called a chromosome.

Chromatin and chromosomes

DNA is found in the nucleus of eukaryotic cells. DNA can take two forms in the nucleus. **Chromatin** (KROH muh tun) is the relaxed form of DNA. However, the DNA is not relaxed at all times. **Chromosomes** (KROH muh sohmz) are condensed structures that contain the DNA that are visible during mitosis. Chromosomes are passed from generation to generation of cells.

Eukaryotic DNA is organized into chromosomes. Human chromosomes range in length from 51 million to 245 million base pairs. The phosphate groups in DNA create a negative charge, which attracts the DNA to the positively charged histone proteins and forms a **nucleosome**. The nucleosomes group together into chromatin fibers, which supercoil to make up the structure recognized as a chromosome, shown in **Figure 3**.

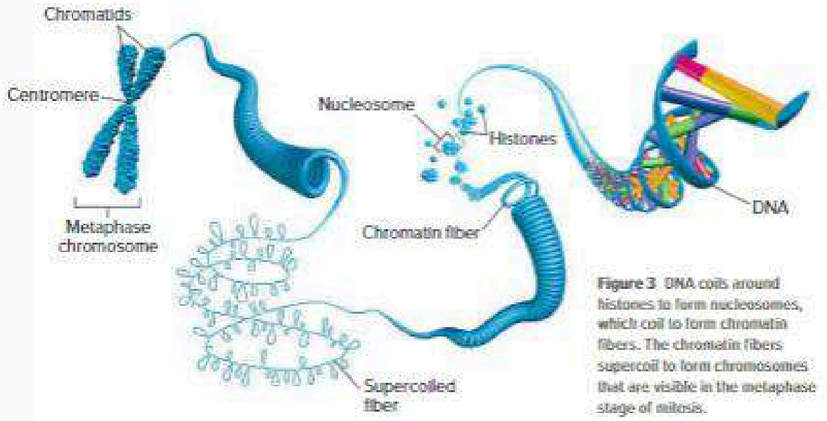


Figure 3 DNA coils around histones to form nucleosomes, which coil to form chromatin fibers. The chromatin fibers supercoil to form chromosomes that are visible in the metaphase stage of mitosis.

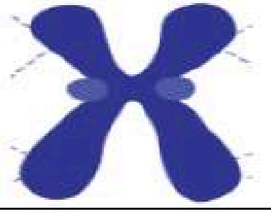
Chromatin and Chromosomes

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- **Chromosomes** are condensed structures that contain the DNA that are visible during mitosis.
- They are passed from generation to generation.
- Eukaryotic DNA is organized into chromosomes.
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Homologous Chromosomes

- Human body cells have 46 chromosomes. Each parent contributes 23, resulting in 23 pairs of chromosomes.
- Chromosomes that make up a pair, one from each parent, are called **homologous chromosomes**.
- Homologous chromosomes have the same length and centromere position. They carry genes that control the same traits.

16	Describe how the egg and sperm cells contain only one chromosome of each parent's chromosome pair		234

Q6.	What is the image below? 
a.	Chromosome
b.	Chromatid
c.	Centromere
d.	Centriole

Q3.	Where does a cell contain it's genetic material?
a.	cytoskeleton
b.	nucleolus
c.	golgi apparatus
d.	nucleus

Chromatin fiber is made up of nucleosomes, which are made up of ___ wrapped around beadlike proteins called ___.

- **A)** DNA; histones
- **B)** DNA; chromosomes
- **C)** histones; DNA
- **D)** histones; chromosomes

Correct Answer

A) DNA; histones

2. Which is not a characteristic of homologous chromosomes?

- Homologous chromosomes have the same length.
- Homologous chromosomes have the same centromere position.
- C — Homologous chromosomes have the exact same type of allele at the same — CORRECT
- Homologous chromosomes pair up during meiosis I.

17	Describe how the egg and sperm cells contain only one chromosome of each parent's chromosome pair	Figure5	236

Mitosis

Mitosis (mi TOH sus) is the stage of the cell cycle during which the cell's nucleus and nuclear material divide. During mitosis, the cell's replicated genetic material separates and the cell prepares to split into two cells. The key activity of mitosis is the accurate separation of the cell's replicated DNA. This enables the cell's genetic information to pass into the new cells intact, resulting in two daughter cells that are genetically identical. In multicellular organisms, the process of mitosis increases the number of cells as a young organism grows to its adult size.

Organisms also use mitosis to replace damaged cells. Recall the last time you were accidentally cut. The body's process of healing the cut involves generating new skin cells. These new cells are produced by your existing skin cells. Under the scab, the existing skin cells divided by mitosis and cytokinesis to create new skin cells that filled the gap in the skin caused by the injury. Mitosis is also important for maintaining chromosome number in organisms that undergo asexual reproduction.

Get It?
Explain the role of mitosis in the processes of growth and repair.

The stages of mitosis

Mitosis is divided into four stages: prophase, metaphase, anaphase, and telophase. The stages occur in the same order during each mitotic division.

Prophase The first and longest of the four stages is called **prophase.** In this stage, the cell's chromatin condenses to form chromosomes. At this point, each chromosome is a single structure containing the genetic material that was replicated during interphase.



SEM Magnification: unavailable

Figure 5 Chromosomes in prophase are actually sister chromatids that are attached at the centromere.

In prophase, the chromosomes are shaped like an X, as shown in **Figure 5**. Each half of this X is called a sister chromatid. **Sister chromatids** are structures that contain identical copies of DNA.

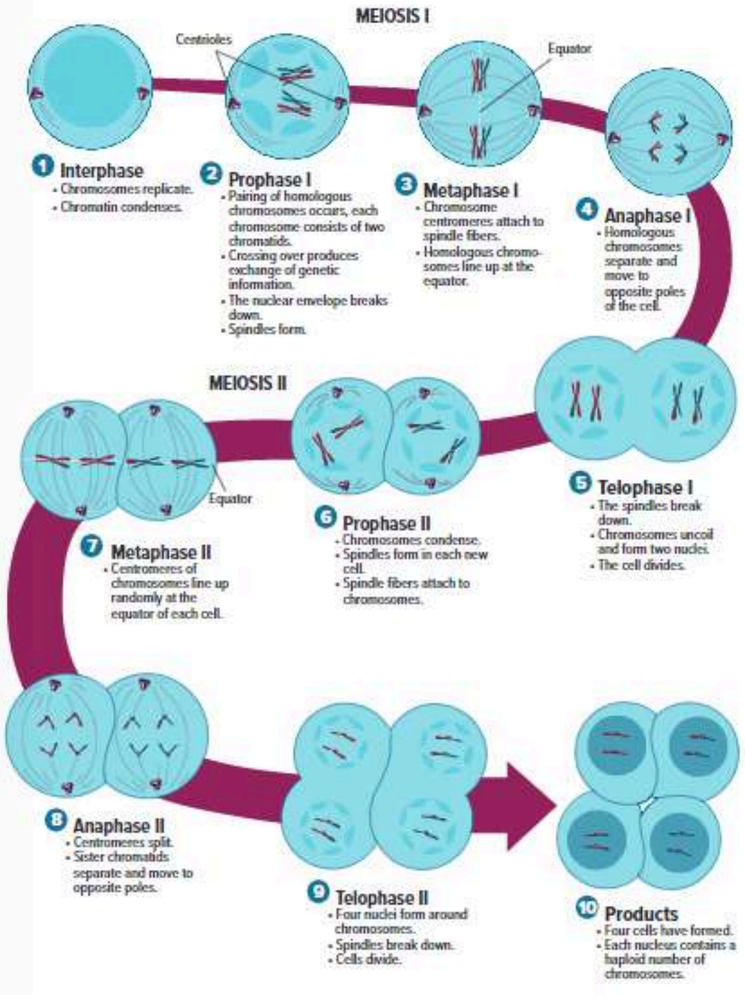
The structure at the center of the chromosome where the sister chromatids are attached is called the **centromere.** A centromere is important because it ensures that a complete copy of the replicated DNA will become part of the daughter cells at the end of the cell cycle.

Locate prophase in the cell cycle diagram illustrated in **Figure 6** on the next page, and note the position of the sister chromatids in the nucleus. As you continue to read about the stages of mitosis in this lesson, refer to **Figure 6** to follow the chromatids through metaphase, anaphase, and telophase. Use the diagram to track the changes that occur as the cell moves through the cell cycle.

18	Recall that meiosis, a specialized type of cell division in sexual reproduction	Figure18	248

Figure 18 Visualizing Meiosis

Follow along the stages of meiosis I and meiosis II, beginning with interphase at the left.



MEIOSIS

- Gametes form during **meiosis**, a type of cell division that reduces the number of chromosomes.

Interphase

- Chromosomes replicate. Chromatin condenses.

Prophase I

- Homologous chromosomes pair. Each chromosome consists of two chromatids. Crossing over produces the exchange of genetic information. The nuclear envelope breaks down. Spindles form.

Metaphase I

- Chromosome centromeres attach to spindles. Homologous chromosomes line up at equator.

Anaphase I

- Homologous chromosomes separate and move to opposite poles of the cell.

Telophase I

- Spindles break down. Chromosomes uncoil to form two nuclei. The cell divides.

Prophase II

- Chromosomes condense. Spindles form in each new cell. Spindle fibers attach to chromosomes.

Metaphase II

- Centromeres of chromosomes line up randomly at the equator of each cell.

Anaphase II

- Centromeres split. Sister chromatids separate and move to opposite poles.

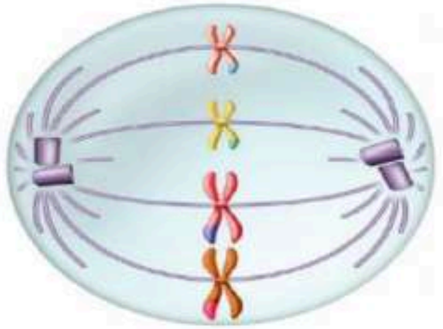
Telophase II

- Four nuclei form around chromosomes. Spindles break down. Cells divide.

Products

- Four cells have formed. Each nucleus contains a haploid number of chromosomes.

18	Recall that meiosis, a specialized type of cell division in sexual reproduction	Figure18	248

Q2.	 Which stage of meiosis is illustrated above?
a.	Prophase I
b.	Prophase II
c.	Metaphase I
d.	Metaphase II

Q3.	What is the next step for the chromosomes illustrated above?
a.	They will experience replication.
b.	They will experience fertilization.
c.	Their number per cell will be halved.
d.	They will divide into sister chromatid.

Q8.	Which of the following does not contribute to genetic variation?
a.	Chromosome number
b.	Crossing over
c.	Meiosis
d.	Random mating

Q13.	In a cell undergoing meiosis, during which stage do the sister chromatids separate from each other?
a.	Anaphase I
b.	Anaphase II
c.	Telophase I
d.	Telophase II

Q15.	DNA replication takes place only once in meiosis, and it results in _____ haploid gametes.
a.	2
b.	3
c.	4
d.	5

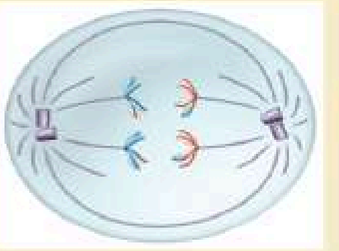
18	Recall that meiosis, a specialized type of cell division in sexual reproduction	Figure18	248

3. Which does not occur during telophase II?

- A Chromosomes condense. CORRECT
- Spindles break down.
- Four nuclei form around chromosomes.
- Cells divide.

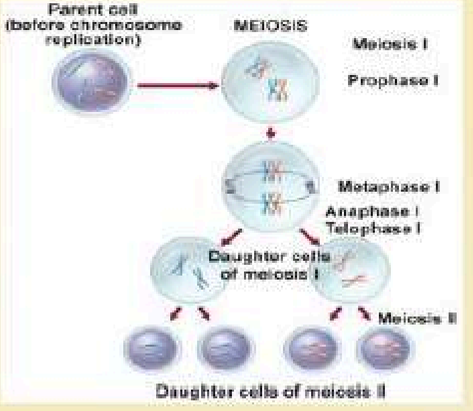
What is the next step for the chromosomes illustrated?

A. Chromosomes replicate.
B. Chromosomes move to opposite poles.
C. Chromosomes uncoil and form two nuclei.
D. Chromosomes line up at the equator.



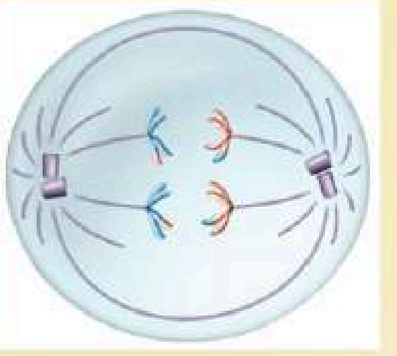
At what stage is the chromosome number reduced from *2n* to *n*?

A. prophase I
B. metaphase I
C. anaphase I
D. meiosis II



Which stage of meiosis is illustrated?

A. prophase I
B. interphase
C. anaphase I
D. anaphase II



20	Describe how the egg and sperm cells contain only one chromosome of each parent's chromosome pair	Figure3	234

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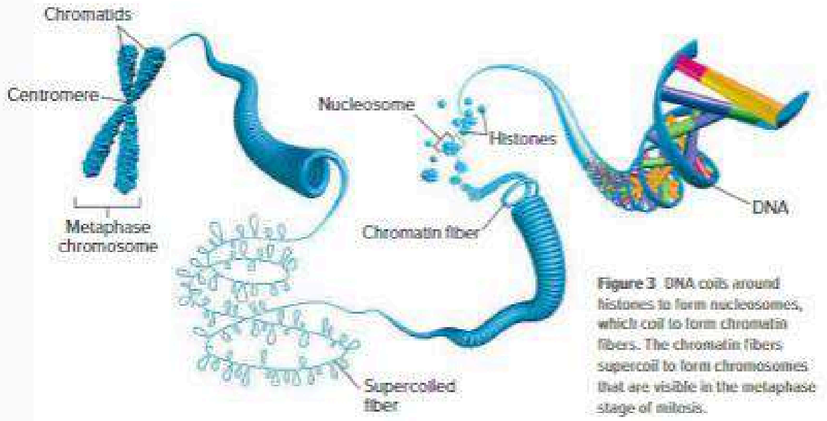


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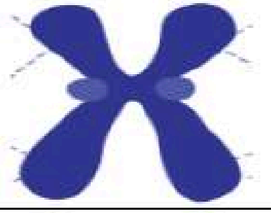
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كله اختياري

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مدرسه خليفه بن زايد للتعليم الثانوي .

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