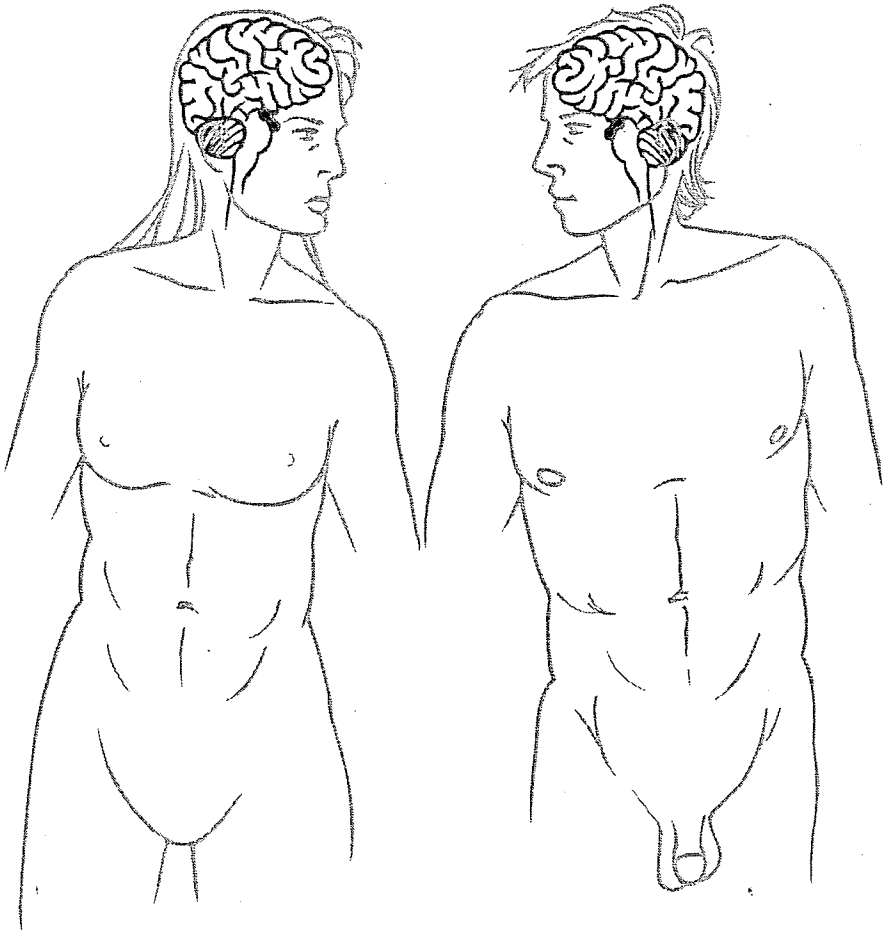
~~Section 4.3~~ Unit 13
Reproduction

Section Overview

The major function of the reproductive system is to ensure survival of the species. Other systems in the body, such as the nervous and urinary systems, work continuously to maintain homeostasis for survival of the individual. An individual may live a long, healthy, and happy life without producing offspring, but if the species is to continue, at least some individuals must produce offspring.

This final section in the course focuses on both male and female reproductive systems and within each, what factors may affect them.



Lesson 4.3A
Male Reproductive Anatomy

Overview

Human reproduction is a complex process, as you are no doubt aware. The brain is tuned to behave and respond to others, often without our being aware or it. It determines, and to a large extent this affects how we interact socially. In this course you are only responsible for understanding the human reproductive system and the hormones that control it. The effect of pregnancy on hormone levels will be briefly discussed, but the course does not cover fetal development.

Resource List

- *Inquiry Into Life*
- *Biology 12 Provincial Exam Preparation package*
- *Biology 12 Web site*
  http://www.openschool.bc.ca/courses/biology/bi12/mod4.html

Male Reproductive Anatomy

Before you begin your study of human reproduction, you need to be familiar with the anatomy of the male and female reproductive systems. This lesson focuses on male reproductive anatomy. As you read the following descriptions, refer to the diagram in this lesson and the one in your *Inquiry Into Life* textbook on page 416.

External Anatomy

The primary function of the **penis** is to deposit sperm inside the vagina of a female during copulation. It also contains the final few centimetres of the urethra.

The **scrotum** is a sac consisting of skin, with embedded muscles, that contains the testes. The scrotum plays an important role in temperature regulation. As body temperature drops, the muscles in the wall of the scrotum contract, pulling the testes up against the body wall and helping them to retaining heat. Sperm formation in the testes will only take place at a few degrees below body temperature, so the testes are suspended outside the body in order for this to happen.

Internal Anatomy

The **testes** produce sperm and the male reproductive hormone testosterone. In the next lesson you will study sperm formation in more detail.

The **epididymis** is a folded tube in which sperm spend time acquiring their tails and maturing, which is required for them function properly.

The **ductus deferens** (vas deferens) is the tube that carries sperm from the epididymis through a circuitous route through the body wall, the prostate, and finally the urethra.

The **prostate** (not prostrate, which means to lay flat) is a gland that produces secretions that buffer the acidic environment of the vagina, assuring that a hostile environment does not destroy the sperm. Prostate cancer or enlargement afflicts many older men, making urination difficult. Regular prostate exams as men approach middle age can detect prostate cancer, increasing the possibility of early detection.

A pair of **seminal vesicles** flanks the prostate. Seminal vesicles produce fluids, including fructose, to fuel sperm as they move through the female reproductive system. The hormone prostaglandin is also produced there. Prostaglandins have a powerful but short-lived effect on muscles, causing them to contract. They act on the wall of the vagina and uterus, causing them to contract, which allows the passage of sperm into the uterus. This enhances the possibility of fertilization.

Cowper's gland (bulbourethral) is a small gland that secretes lubricants to assist the sperm in their journey. Recent studies suggest these may produce antibodies against sperm from other individuals. Other species also have methods for preventing fertilization from competing males.

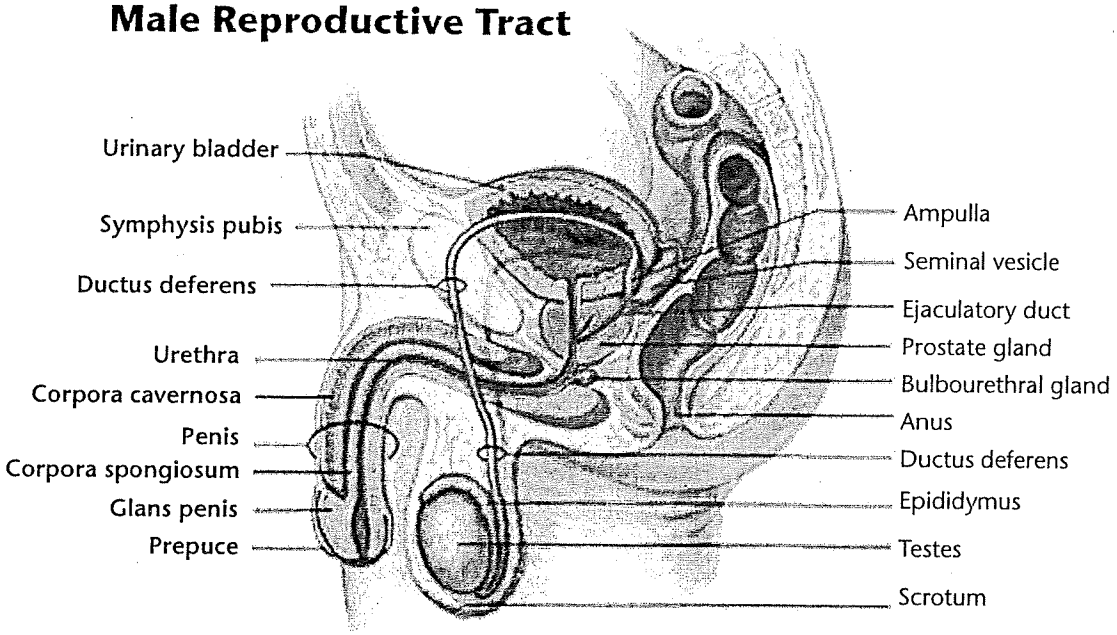
If you have access to the Internet, go to the *Biology 12 Web site* Lesson 4.3A Male Reproductive Anatomy to read a scholarly article about this ability in birds.

The reproductive and urinary systems share a tube called the **urethra**. During copulation, it carries seminal fluid out of the body during orgasm. It also carries urine during urination.

The male gametes are called **sperm**.

The **seminal fluid** (semen) is made up of sperm and the secretions from various reproductive glands. If a male is sterile, sperm are produced in insufficient numbers to cause fertilization. If the vas deferentia are tied artificially (vasectomy), seminal fluid is produced, but without sperm.

Male Reproductive Tract



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This diagram is similar to the one on page 416 in your *Inquiry Into Life* text. It is a mid-saggital section. Some organs are off centre, and technically don't belong in this view. The diagram in your *Inquiry Into Life* text also includes a view from the front, so you can see which organs are in this category.

Guided Practice 4.3A 1

Study Flash Cards

Using the information in your lessons, the *Inquiry Into Life* textbook, and the *Biology 12 PEP*, make a study flash card for each of the following vocabulary terms. Be sure the information is in your words, as that will be more meaningful to you.

Vocabulary terms to know for this lesson:

- Cowper's gland (bulbourethral gland)
- epididymis
- penis
- prostate
- scrotum
- seminal vesicles
- testes
- vas deferens (ductus deferens)

Summary

There is no section assignment for this lesson.

Completing this lesson has helped you to:

- identify the structures of the male reproductive anatomy and describe their functions
- list the components seminal fluid and identify the structures that produce them

Lesson 4.3B
Sperm Anatomy and the Pathway of Seminal Fluid

Overview

Sperm may seem like simple structures whose only job is to carry DNA from the male to the female, but they are more complex than that. In this lesson you will learn to recognize and name the anatomy of sperm, and describe the path of sperm as it leaves the body.

Resource List

- *Inquiry Into Life*
- *Biology 12 Provincial Exam Preparation package*
- *Biology 12 Web site*
  http://www.openschool.bc.ca/courses/biology/bi12/mod4.html

Sperm Anatomy

Sperm cells are present in almost all plant and animal species, and their dependency on a watery environment has persisted through time. This almost always requires the sperm to have the ability to swim, so the cells have a tail. In some species, sperm cells have more than one tail. As well there is a "motor"' that contains mitochondria, which provide ATP used in the flagellum to change shape, or beat in a characteristic motion reminiscent of fish or amphibians.

Keep in mind that a sperm cell is a single cell, and its cellular complexity approaches that of some protists. They are short lived. Once released from the body, their life expectancy is only about two days. This means they must be placed inside the female within two days of ovulation for fertilization to occur.

Study Figure 21.3 on page 418 of your *Inquiry Into Life* textbook.

The Pathway of Sperm

The pathway of sperm as it leaves the body is straightforward. From the testes, where sperm are produced, the cells travel to the epididymis where they mature. From there, during orgasm, muscular contractions of the epididymis and the vas deferens propel the sperm out of the vas. As they move, they pass several organs, each of which contributes to the seminal fluid. Without these fluids, sperm are incapable of fertilizing an egg. Sperm first pass the seminal vesicles, then the prostate, and finally the Cowper's glands. The final pathway of sperm is the urethra, which leads out of the body.

Several malformations, either natural or artificial, can prevent sperm from moving through this pathway. Most notable are vasectomy and scarring, which is caused by bacterial infections of the inner lining of the tube. Sexually transmitted diseases, such as syphilis and gonorrhea, produce scarring and reduce fertility.

Note that reduced fertility means there is a reduced chance of producing a fertilized egg (pregnancy). Sterility means the chance is zero.

If you have access to the Internet, go to the *Biology 12 Web site* Lesson 4.3B Sperm Anatomy and the Pathway of Seminal Fluid for more information about reduction in sperm cell counts. Also review "Introduction, Human Male System and Male Anatomy."

Behaviour of Sperm

Depending on a man's physical condition, sperm may be weak swimmers or malformed, often having multiple tails. Some sperm appear to be more interested in fighting than uniting. When sperm from multiple men is mixed together in a vagina, sperm cells compete with one another. This isn't surprising, since it has only been relatively recently, geologically speaking, that mixing sperm was not the norm. Consider the evolutionary advantage of a male producing the best fighting sperm. While engaging the opponent's sperm with a battle royal, others from the same man could be successfully fertilizing the egg. Once fertilized the egg accepts no other sperm.

Guided Practice 4.3B 1

Study Flash Cards

Using the information in your lessons, the *Inquiry Into Life* textbook, and the *Biology 12 PEP*, make a study flash card for each of the following vocabulary terms. Be sure the information is in your words, as that will be more meaningful to you.

Vocabulary terms to know for this lesson:

- acrosome
- head (of sperm)
- mid-piece
- tail (flagellum)

Summary

Now do Section Assignment 4.3 Part A: The Pathway of Sperm.

Completing this lesson has helped you to:

- identify the structures of sperm, how they are formed, and the pathway they follow to pass out of the body
- describe the organs that contribute to seminal fluid and understand their function

Lesson 4.3C
Testosterone and Control

Overview

Like all behaviours, sexual behaviour is controlled by the brain. Under the brain's direction, the male sex hormone testosterone controls sexual maturation, sex drive (libido), and the development of secondary sexual characteristics, such as body hair growth.

In this lesson you will examine the hormonal control of male sexuality.

Resource List

- *Inquiry Into Life*
- *Biology 12 Provincial Exam Preparation package*
- *Biology 12 Web site*
  http://www.openschool.bc.ca/courses/biology/bi12/mod4.html

The Testes Produce Sperm and Hormones

The testes have two roles in reproduction: to produce sperm cells and to produce hormones.

Sperm cell production, called **spermatogenesis**, occurs in the **seminiferous tubules**. Sperm are gametes that result from the cell division process called meiosis. **Meiosis** occurs continuously, from puberty to death, and the process requires a temperature just slightly lower than body temperature.

Hormones are also produced in the testes. Testosterone production occurs in the **interstitial cells** and inhibin is produced in the seminiferous tubules. Hormone secretions are regulated by the anterior pituitary and the **hypothalamus**, and controlled by **negative feedback loop**. The various sex hormones have several functions.

Testosterone

- controls development of primary sex organs
- controls development of secondary sex characteristics, beginning at onset of puberty: growth of body hair, enlargement of vocal cords (causes voice to deepen), growth of adult physique; later it controls receding hair line in male pattern baldness

GnRH (**Gonadotropic Releasing Hormone**)

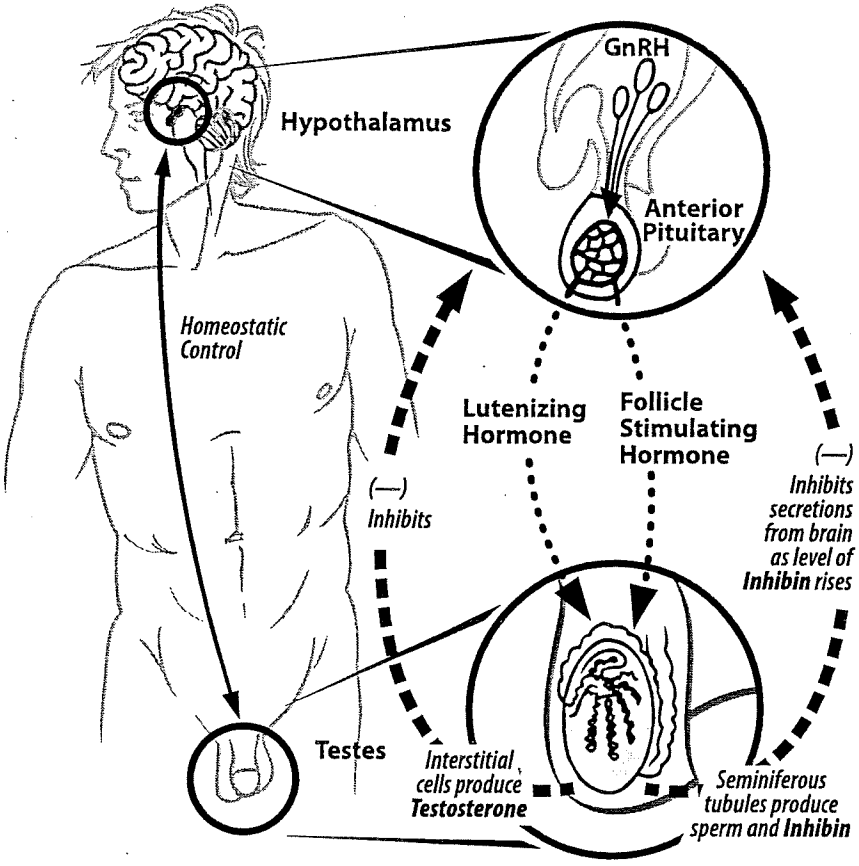
- released by hypothalamus
- stimulates the anterior pituitary to release two controlling hormones (LH and FSH)

Follicle Stimulating Hormone (FSH)

- stimulates production of sperm

Luteinizing Hormone (LH)

- also known as interstitial cell stimulating hormone—ICSH
- stimulates production of testosterone



Study the diagram that shows neuroendocrine control of the testes and note the following characteristics:

- This is a negative feedback loop. Some event, e.g., secretion of LH, causes something to happen (testosterone secretion), which in turn reduces the amount of LH released. This allows hormone levels to be self-regulating.

- Before puberty, very low levels of FSH and LH are released from the brain, and this suppresses sexual development.

- Ultimately the brain is in control of sexual functioning.

- Hormones circulate in the bloodstream, so levels can be monitored. It is possible to introduce artificial levels of hormones that would bring about designed changes in the body, but some side effects would be unpleasant. Read the last paragraph in Hormonal Regulation in Males on page 419 in your *Inquiry Into Life* textbook.

If you have access to the Internet, go to the *Biology 12 Web site* Lesson 4.3C Testosterone and Control and answer the quiz questions 1 to 23 here.

Guided Practice 4.3C 1

Study Flash Cards

Using the information in your lessons, the *Inquiry Into Life* textbook, and the *Biology 12 PEP*, make a study flash card for each of the following vocabulary terms. Be sure the information is in your words, as that will be more meaningful to you.

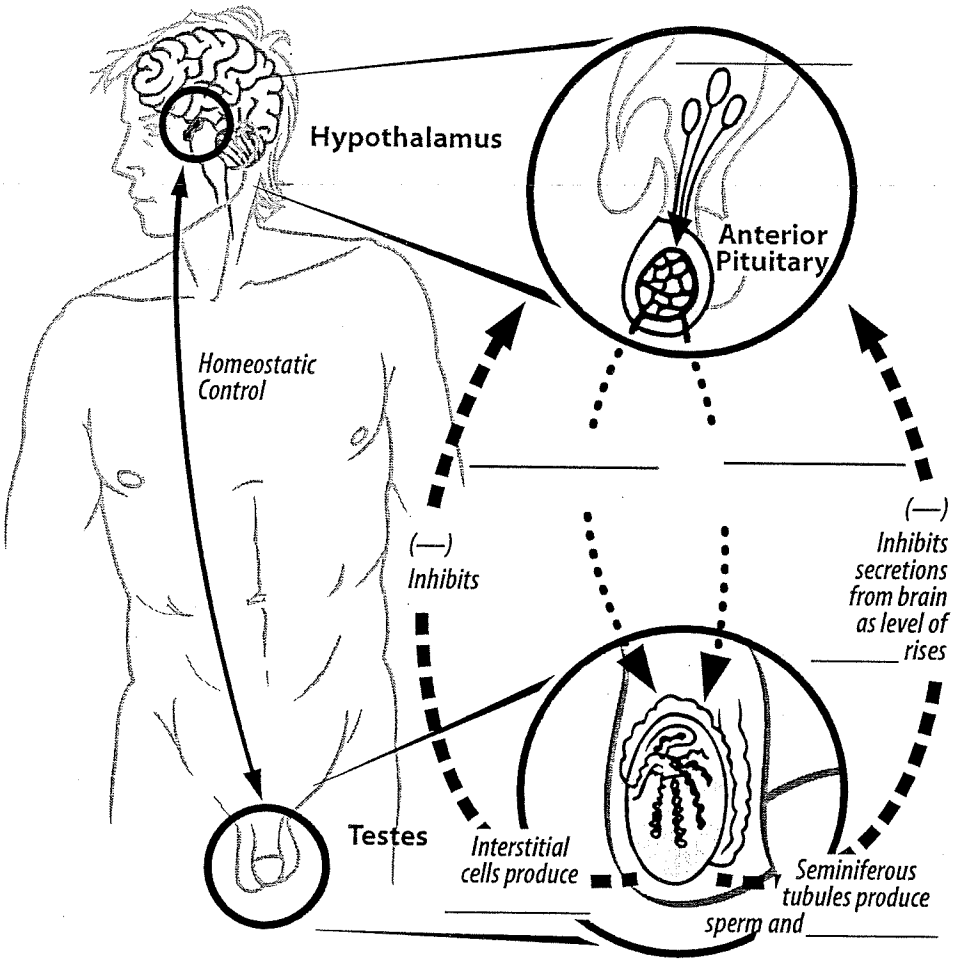
Vocabulary terms to know for this lesson:

- follicle stimulating hormone
- gonadotropic releasing hormone
- hypothalamus
- interstitial cells
- labelling
- luteinizing hormone
- meiosis
- negative feedback loop
- seminiferous tubules
- spermatogenesis
- testosterone

Guided Practice 4.3C 2

Hormonal Control of the Testes

Fill in the names of the hormones in the following feedback loop showing neuroendocrine control of the testes.



Summary

Now do Section Assignment 4.3 Part B: Testosterone Control.

Completing this lesson has helped you to:

- describe the functions of testosterone
- describe the homeostatic regulation of testosterone levels by the hypothalamus, anterior pituitary, and testes

Lesson 4.3D
Female Reproductive Anatomy

Overview

This lesson focuses on the basic reproductive anatomy and processes of human females. You may be surprised to learn that in spite of the obvious physical differences between males and females, the development of sexual structures is quite similar.

Resource List

- *Inquiry Into Life*
- *Biology 12 Provincial Exam Preparation package*
- *Biology 12 Web site*
  http://www.openschool.bc.ca/courses/biology/bi12/mod4.html

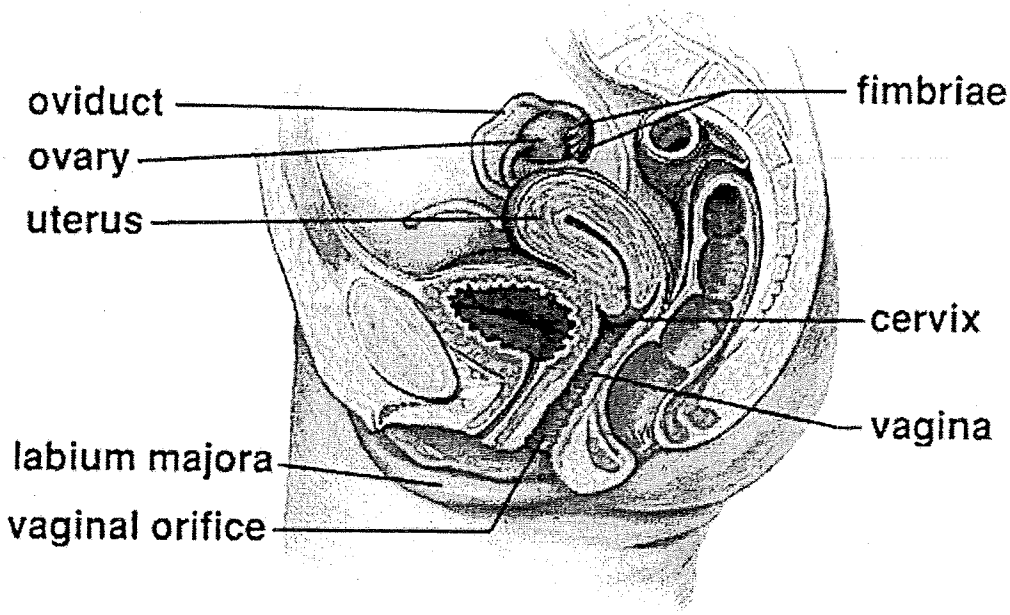
Anatomy of the Female Reproductive System

At the most basic level the reproductive system performs the following functions:

- provides a vessel for development and nourishment of the fetus
- accepts sperm from male and channels them to egg
- produces eggs
- produces sex hormones, progesterone and estrogen

Internal Anatomy

This is a mid-saggital view. Some paired structures, such as the ovaries, are not on the midline, so only one appears in this view.



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In your *Inquiry Into Life* textbook on page 420, study the Figure 21.5, The female reproductive system.

The **ovaries** have two roles in reproduction: to produce **egg** cells and to produce hormones. Egg production, called oogenesis, takes place in the follicle of the ovary. Eggs are gametes that result from the sexual cell division process called meiosis. This process occurs continuously from puberty to menopause, which occurs at about age 45 to 55.

Eggs are produced cyclically, about once every 28 days. Each time, one or two will eggs mature. At puberty the ovary contains all the primary **oocytes** (beginning eggs) that a female has. Over time, some oocytes deteriorate, which can lead to genetic abnormalities. The chance of deterioration increases with age.

Hormone production occurs in the developing **follicle** (mainly **estrogen**) and the **corpus luteum** (primarily **progesterone**). Hormone production is regulated by secretions from the anterior pituitary. This is similar to hormone regulation in males, but is more cyclic, and it is controlled by negative feedback loop.

Eggs are released from the ovary and collected by cilia on the **fimbriae**. These sweep the eggs into the oviduct (**fallopian tube**). If missed, the egg could float out into the body cavity. Rarely this leads to ectopic pregnancy where the egg, if fertilized, embeds on the external wall of an organ, usually the fallopian tube. This condition does not lead to proper fetal development.

Once in the fallopian tube, the egg is moved by muscular contractions. This journey lasts for one to two days. It is during this time that the egg must be fertilized for it to develop into an embryo. Eventually the egg enters the uterus, a hollow muscular organ.

The **uterus** is lined with a spongy tissue, the endometrium. If the egg is fertilized, it embeds itself in the endometrium, which nourishes its early development by providing oxygen and nutrients by diffusion.

The uterus opens into the vaginal canal through an opening called the **cervix**. Both the uterus and the vagina are very elastic and can stretch to several times their usual size to accommodate a fetus. The vaginal canal opens posterior to the urethral opening and anterior to the anus.

External Anatomy

A series of folded tissues, the **vulva**, collectively surround the vaginal opening. Anterior to the urethral opening is the clitoris. The **clitoris** contains a collection of nerve endings, similar in number to those in the penis in males. In fact many reproductive structures in males and females have a similar embryonic development, although not necessarily the same function. The following chart summarizes these homologies.

Male	Female
Testes	Ovaries
Penis	Clitoris
lower surface of penis	labia minoria
scrotum	labia majora

As in males, the development of female secondary sexual characteristics depends on levels of circulating sex hormones. These secondary sexual characteristics include breast development (males have undeveloped breasts), slight deepening of the voice, growth of body hair, muscular development, and a small growth of fatty tissue just below the umbilicus.

If you have access to the Internet, go to the *Biology 12 Web site* Lesson 43.D Female Reproductive Anatomy and see 2-D and 3-D images/movies of real bodies (male and female) shown as cross-sections. See if you can find parts of the female reproductive system in these pictures.

Guided Practice 4.3D 1
Study Flash Cards

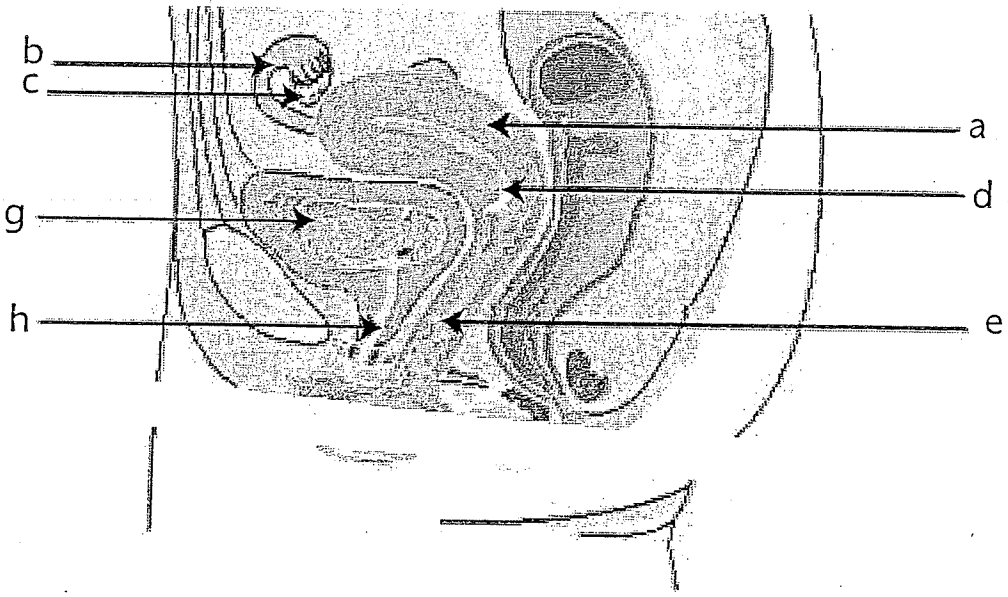
Using the information in your lessons, the *Inquiry Into Life* textbook, and the *Biology 12 PEP*, make a study flash card for each of the following vocabulary terms. Be sure the information is in your words, as that will be more meaningful to you.

Vocabulary terms to know for this lesson:

- cervix
- clitoris
- endometrium
- fallopian tube
- fimbriae
- ovary
- uterus
- vaginal canal
- vulva

Guided Practice 4.3D 2
Multiple Choice

Use the following diagram to answer all the questions.



1. What is represented by the structure labeled b?

   A. The ovary

   B. The uterus

   C. The vagina

   D. The oviduct

2. Which labeled structure secretes hormones that cause the changes that occur in the female body during puberty?

   A. a

   B. b

   C. c

   D. d

3. What is represented by the structured labeled a?

   A. The uterus

   B. The vagina

   C. The oviduct

   D. The ovary

4. Which labeled structure secretes hormones that cause the changes that occur in the female body during puberty?

   A. e

   B. f

   C. g

   D. d

5. The _____ contains a collection of nerve endings, similar in number to those in the penis in males.

   A. uterus

   B. vagina

   C. ovary

   D. clitoris

Summary

There is no section assignment for this lesson.

Completing this lesson has helped you to:

- identify and describe the functions of the structures of the female reproductive system

Lesson 4.3E
Ovarian and Uterine Cycles

Overview

The cycle of female hormone secretions begin at puberty and continue until menopause. With each cycle, the uterus prepares for pregnancy, sloughs off prepared tissue, and prepares again. These cycles are only interrupted by pregnancies or occasional ill health. In this lesson you will learn how some basic hormonal variations influence the ovaries and brain.

Resource List

- *Inquiry Into Life*
- *Biology 12 Provincial Exam Preparation package*
- *Biology 12 Web site*
  http://www.openschool.bc.ca/courses/biology/bi12/mod4.html
- *Biology 12 Media CD*

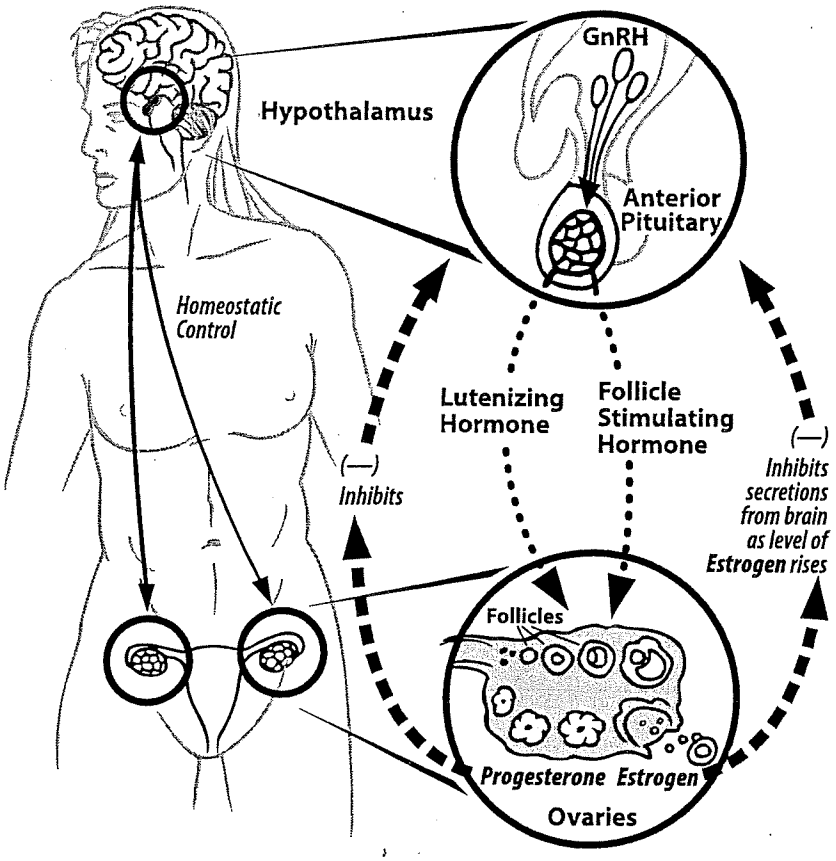
The Ovarian Cycle

Throughout the adult life of the human female, her ovaries respond to neuroendocrine control by undergoing changes that produce eggs and the sex hormones estrogen and progesterone. Feedback to the brain signals the rise and fall of two neuroendocrine hormones, both familiar to you already, LH and FSH. In females these play similar roles as they did in males. FSH stimulates the maturation of the **follicle** and LH, which stimulates the maturation of the corpus luteum.

Look at Figure 21.7 on page 422 in your *Inquiry Into Life* textbook, a diagram relating to the ovarian cycle. It shows the events that make up an ovarian cycle, beginning at the top left and ending at the bottom left. In reality, all of these events occur over a period of about one month, and in one place within the ovary. The events numbered 1 to 3 occur in the first fourteen days of the ovarian cycle and those numbered 4 to 6 take place during the last 14 days.

Notice that **ovulation**—the release of the egg—occurs in the middle of the cycle and is caused by a sudden spike of LH. Some women notice this as a slight pain called Mittelschmerz, from German meaning "middle pain." Trace the development of the egg inside the **primary follicle**, to the **secondary follicle**, and eventually the **Graafian follicle**. The secondary and Graafian follicles produce the sex hormone estrogen, which is released into the blood stream. After the Graafian follicle ruptures, the empty follicle is known as the corpus luteus (body yellow), named for its colour. The corpus luteum continues to secrete the sex hormone progesterone.

Also in your *Inquiry Into Life* textbook on page 423, study Figure 21.8, Hormonal control of the ovaries. This diagram is very similar to Figure 21.4 that shows hormonal control of the testes in males. Apart from details of the processes involved in gamete production, they are almost identical. What male hormone is homologous to estrogen? What male hormone is homologous to progesterone?



The Uterine Cycle

Within the uterus, conditions change according to secretions of sex hormones from the ovary. While the ovary is involved with egg production, the uterus prepares for the egg's arrival. The endometrial wall goes through three distinct phases, each corresponding to events within the ovary. Note that the number of days given are averages. The actual length of a cycle varies from woman to woman.

Menstruation —

- days 1 to 5
- wall developed in previous cycle is sloughed off if no fertilized egg is present; should there be a fertilized egg, then the uterine cycle ceases as the embryo develops; this, too, is under hormonal control—read Menstruation on page 424 of the *Inquiry Into Life* textbook
- often associated with pain—read Painful Menstruation and Premenstrual Syndrome on page 424 of the *Inquiry Into Life* textbook

Proliferation Phase —

- days 6 to 13
- endometrial wall thickens as it develops new tissue and blood vessels
- ends with ovulation, day 14-for an embryo to develop, the egg must be fertilized within a couple of days of ovulation

Secretory Phase —

- days 15 to 28
- secretes mucous, which accumulates in strands inside the uterus; these provide a pathway for sperm that must swim through the uterus and into the fallopian tubes to meet with the egg. Later the mucous traps the fertilized egg, which eventually embeds into the uterine wall. If the egg is not fertilized, it degenerates.
- without a fertilized egg, the **endometrium** begins to degenerate and the cycle begins at day one again.

Interrelationships of the Uterine and Ovarian Cycle and Neuroendocrine Control

The timing of and relationships between hormone levels, ovarian events, and uterine events may seem complex, but it's easy to understand if we break it down into separate events. Just keep in mind that these events are related to each other, and that they control each other in a negative feedback system.

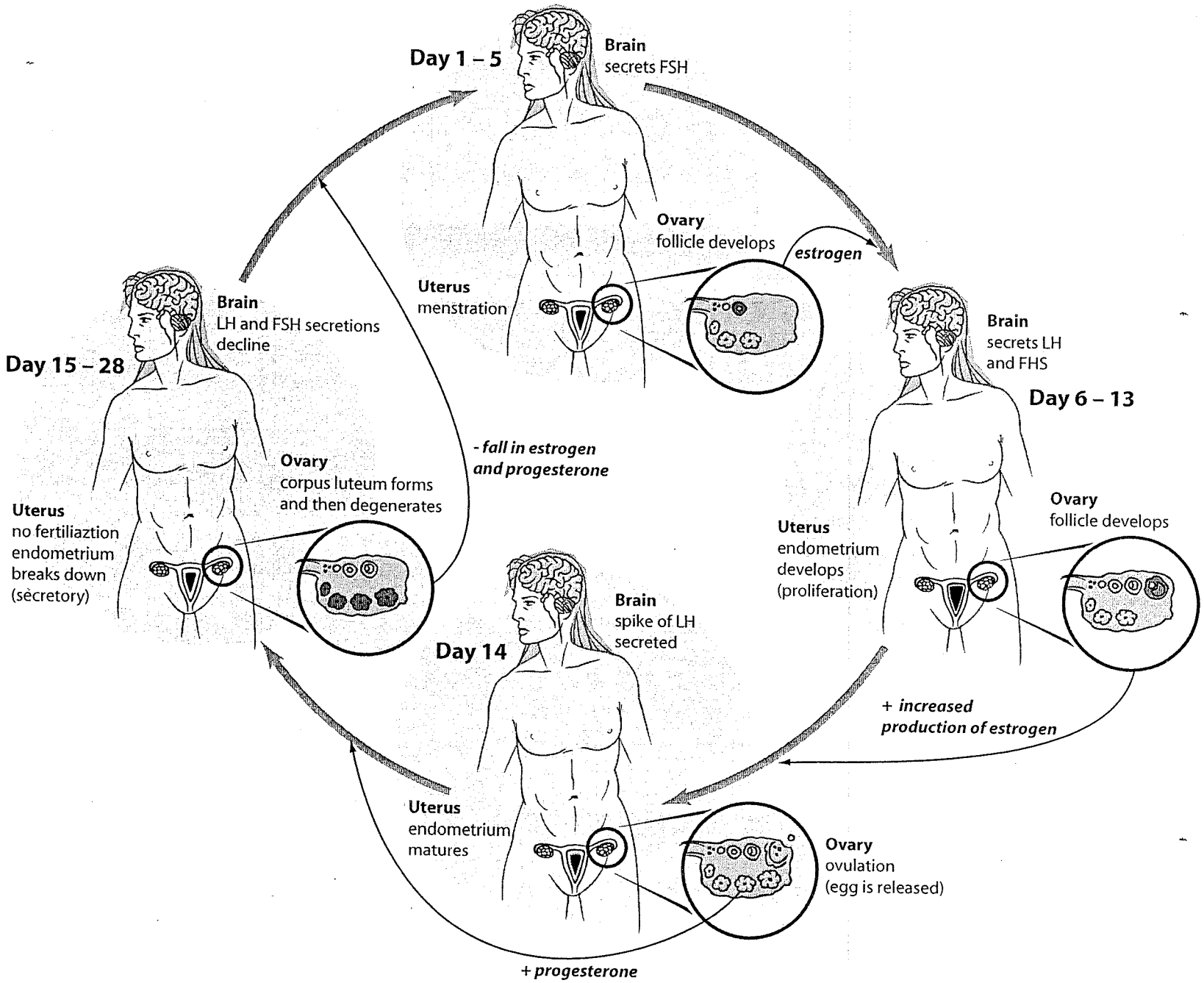
Take a look on the next page at the diagram of the interrelationships between the ovary, uterus, and brain.

Follow the arrows through each cascade of events. Notice that events in one organ control those in the others. Hormones are the communicators. Then take a look at Figure 21.9 on page 425 in the *Inquiry Into Life*. The diagram in the *Inquiry Into Life* textbook does not describe the controls, so be sure to study the one provided here in the lesson. On the provincial exam, students are often asked questions about the control mechanisms.

 If you have access to a computer and the *Biology 12 Media CD*, watch *The Female Cycle* now.

Go to your:

Biology 12 Media CD > Module 4 > **The Female Cycle.**



Interrelationships Between the Ovary, Uterus, and Brain

Guided Practice 4.3E 1

Study Flash Cards

Using the information in your lessons, the *Inquiry Into Life* textbook, and the *Biology 12 PEP*, make a study flash card for each of the following vocabulary terms. Be sure the information is in your words, as that will be more meaningful to you.

Vocabulary terms to know for this lesson:

- anterior pituitary
- endometrium
- fertilization
- follicle
- follicle-stimulating hormone (FSH)
- Graafian follicle
- hypothalamus
- luteinizing hormone (LH)
- menstruation
- ovulation
- primary follicle
- proliferation phase
- secondary follicle
- secretory phase

Guided Practice 4.3E 2

Written Response

Explain the relationship between the named structures.

1. FSH and the follicle
2. LH and the corpus luteum
3. Secondary oocyte and sperm
4. Endometrial wall and fertilized egg
5. Ovary and uterus
6. Endometrium and corpus luteum
7. Endometrium and follicle

If you have access to the Internet, go to the *Biology 12 Web site* Lesson 4.3E Ovarian and Uterine Cycles to answer similar questions. Questions 24–46 are pertinent to this lesson but don't be afraid to attempt more questions.

Summary

There is no section assignment for this lesson.

Completing this lesson has helped you to:

- describe the sequence of events in the ovarian cycle, with reference the follicular phase, ovulation, and the luteal phase
- describe the sequence of events in the uterine cycle, with reference to menstruation, the proliferative phase, and the secretory phase
- describe the control of the ovarian and uterine cycles by hormones including gonadotropin-releasing hormone (GnRH), follicle-stimulating hormone (FSH), luteinizing hormone (LH), estrogen, and progesterone

Lesson 4.3F
Hormone Changes Associated with Implantation

Overview

During pregnancy the female body undergoes a number of changes necessary to preserve the endometrial wall and suspend the ovarian and uterine cycles, provide nourishment for the developing fetus, and prepare to nurse the baby after birth. All of these are under hormonal control, as are the events centred on birth, which are controlled by the hormone oxytocin.

You are only responsible for knowing the various events that occur during pregnancy that are under hormonal control. However, it will be interesting for you to read Chapter 22, "Development and Aging" in the *Inquiry Into Life* .

Resource List

- *Inquiry Into Life*
- *Biology 12 Provincial Exam Preparation package*

Human Chorionic Gonadotropin

During pregnancy the cyclic rhythm of ovarian and uterine events is altered. The fertilized egg embeds in the endometrial wall, which has been preparing for its arrival during the secretory phase of the uterine cycle. When the fertilized egg arrives, it buries itself into the wall (**implantation**).

Almost immediately the surrounding tissue begins to produce the hormone **human chorionic gonadotropin** (HCG). The presence of this hormone in the urine is the basis for the modern pregnancy test. HCG sustains the corpus luteum, which continues to produce progesterone. In other words, HCG has the same effect as LH, but it is not produced by the brain. The presence of the embryo overrides the brain's control of the reproductive system, and the presence of progesterone maintains the endometrium.

What would happen to the embryo if no HCG were produced? The corpus luteum would disintegrate, ceasing the production of progesterone. The anterior pituitary would begin to produce greater levels of FSH and the endometrium would respond by disintegrating, causing the embryo to be miscarried.

As the embryo develops it contributes tissue to the development of placenta. The endometrium also contributes tissue. Think of the placenta as two interlocking hands, each touching the other but not directly connected. Where the two tissues touch there are blood vessels from each of the endometrium and the embryo. Across this narrow gap, the embryo receives oxygen and nutrients. It also passes nitrogen wastes and carbon dioxide to the mother, whose organs dispose of them. Eventually the tissues of the placenta take over progesterone production, suppressing production of FSH by the brain and assuring its own maintenance.

Oxytocin

With very few exceptions, homeostasis involves negative feedback, designed to achieve balance. In the case of childbirth, the process is not about balancing an internal environment but bringing about a radical change that will initiate childbirth. This is a rare case of a **positive feedback loop**.

As the end of pregnancy nears, the uterus begins to contract, forcing the fetus into the bottom of the uterus, where it applies pressure to the cervix. As the cervix begins to stretch, it sends neural messages to the brain, which signals the release of **oxytocin** from the posterior pituitary. Oxytocin stimulates more contractions, which result in further stretching of the cervix. Contractions become more intense as oxytocin levels rise.

Eventually, uterine contraction forces the baby through the vaginal canal, allowing the cervix to contract back to its normal size. This contraction of the cervix stops the neural signals to the brain, which in turn stops the release of oxytocin. The uterus continues to contract until it expels the placenta or after-birth. After a few days, the uterus reverts to its pre-pregnant size.

During pregnancy the secretion of progesterone and estrogen by the placenta stimulate the breast to lactate, or produce milk. After childbirth, levels of these hormones fall abruptly and the anterior pituitary begins to produce **prolactin**. It takes a couple of days of exposure to prolactin to fully ready the breasts for milk production. If the baby is allowed to suckle on the nipple, nerve connections with the brain stimulate the release of oxytocin from the posterior pituitary. Oxytocin causes the contraction of milk-containing lobules in the breast. If the baby is not breastfed, there is no stimulation and breast milk is not released. With reduced levels of progesterone and estrogen, the breast reverts to its pre-pregnancy size. The presence of oxytocin in breastfeeding mothers also stimulates their uterus to more quickly revert to its normal size.

This is the last lesson in Biology 12. Congratulations for completing the course!

Guided Practice 4.3F 1

Study Flash Cards

Using the information in your lessons, the *Inquiry Into Life* textbook, and the *Biology 12 PEP*, make a study flash card for each of the following vocabulary terms. Be sure the information is in your words, as that will be more meaningful to you.

Vocabulary terms to know for this lesson:

- human chorionic gonadotropin
- implantation
- oxytocin
- positive feedback loop
- prolactin

Guided Practice 4.3F 2

Pregnancy and Hormones

Select the best answer.

1. The presence in the urine of which hormone is the basis for the human pregnancy tests?
   A. progesterone
   B. estrogen
   C. testosterone
   D. HCG

2. HCG has the same effect on the body as:
   A. estrogen
   B. progesterone
   C. LH
   D. FSH

3. The final effect of HCG is to maintain the:
   A. endometrial wall
   B. secretion of progesterone
   C. corpus luteum
   D. follicle

4. Oxytocin's main purpose before birth is to:
   A. cause contractions of the uterus
   B. stimulate the release of milk from the breasts
   C. maintain the endometrium
   D. stimulate secretion of prolactin

5. Prolactin entirely designed to:

   A. stimulate the contraction of milk-producing glands within the breasts

   B. maintain the corpus luteum

   C. maintain the endometrium

   D. stimulate the maturation of the breasts in preparation for milk production

Summary

Now complete Section Assignment 4.3 Parts: C, D and E.

Completing this lesson has helped you to:

- describe the hormonal changes that occur as a result of egg implantation in the wall of the uterus
- describe a positive feedback mechanism involving oxytocin