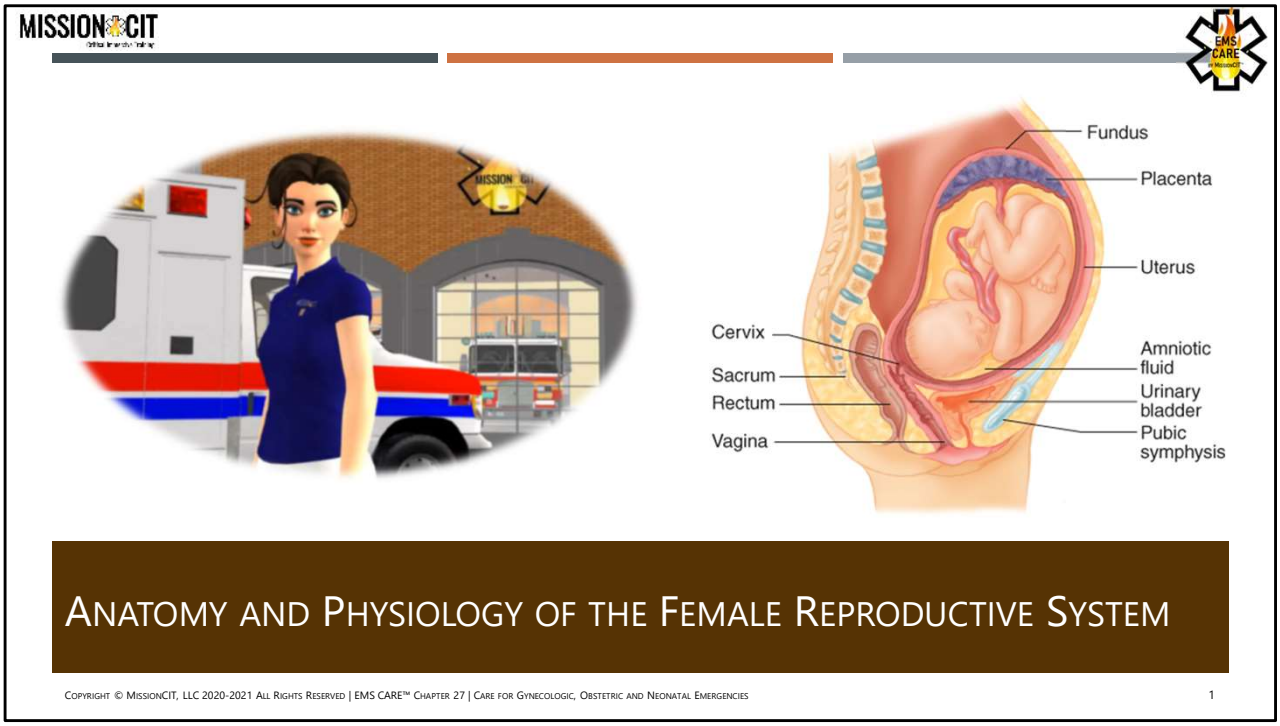
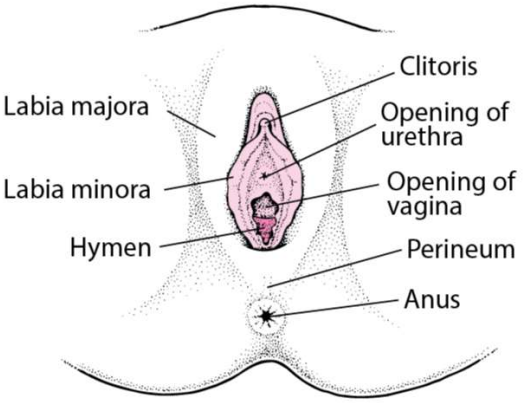


Let's begin with the Anatomy and Physiology of the Female Reproductive System

As we go through the lesson, we discuss female internal and external genitalia, the female reproductive cycle, fertilization and subsequent changes to the female anatomy and reproductive system. Good Studying.

External Genital Organs

- Mons pubis
- Labia Major & Minora
- Perineum
- Vaginal opening
- Labia majora and labia minora
- Clitoris



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According to the Merck Manual, female external genital organs include the mons pubis, labia majora, labia minora, Bartholin glands, and clitoris. The area containing these organs is called the vulva.

The external genital organs have three main functions: Enabling sperm to enter the body, Protecting the internal genital organs from infectious organisms, and providing sexual pleasure.

The mons pubis is a rounded mound of fatty tissue that covers the pubic bone. During puberty, it becomes covered with hair. The mons pubis contains oil-secreting

sebaceous glands. These glands release substances that are involved in sexual attraction called pheromones.

The labia majora which means large lips, are relatively large, fleshy folds of tissue that enclose and protect the other external genital organs. They are comparable to the scrotum in males. The labia majora contain sweat and sebaceous glands, which produce lubricating secretions. During puberty, hair appears on the labia majora.

The labia minora (literally, small lips) can be very small or up to 2 inches wide. The labia minora lie just inside the labia majora and surround the openings to the vagina and urethra. A rich supply of blood vessels gives the labia minora a pink color.

The area between the opening of the vagina and the anus, below the labia majora, is called the perineum. It varies in length from almost 1 to more than 2 inches.

The opening to the vagina is called the introitus. The vaginal opening is the entryway for the penis during sexual intercourse and the exit for blood during menstruation and for the baby during birth.

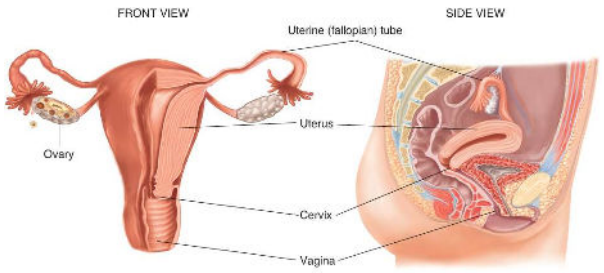
When stimulated, Bartholin glands located beside the vaginal opening, secrete a thick fluid that supplies lubrication for intercourse.

The opening to the urethra, which carries urine from the bladder to the outside, is located above and in front of the vaginal opening.

The clitoris, located between the labia minora at their upper end, is a small protrusion that corresponds to the penis in the male. The clitoris, like the penis, is very sensitive to sexual stimulation and can become erect. Stimulating the clitoris can result in an orgasm.

Internal Genital Organs

- Vagina (part of the birth canal), where sperm are deposited and from which a baby can emerge
- Uterus, where an embryo can develop into a fetus
- Fallopian tubes (oviducts), where a sperm can fertilize an egg
- Ovaries, which produce and release eggs



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The internal genital organs include the vagina, uterus or the womb, cervix, ovaries, and the fallopian tubes. Let's look into each of them now.

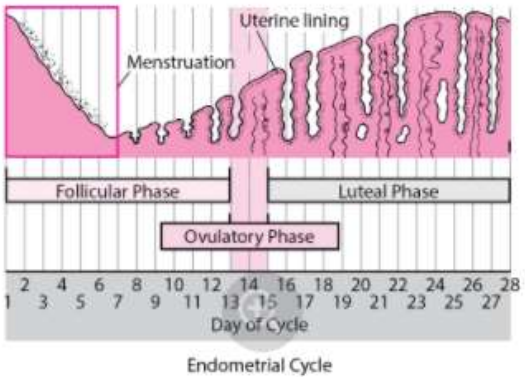
- The vagina is a tube like, muscular but elastic organ about 4 to 5 inches long in an adult woman. It connects the external genital organs to the uterus. The lower third of the vagina is surrounded by elastic muscles that control the diameter of its opening.
- Uterus or womb is the internal organ where a fetus grows and develops before birth. The uterus consists of the cervix and the main body or corpus. Sperms

can enter and menstrual blood can exit the uterus through a channel in the cervix called the cervical canal and this cervical canal is usually narrow, but during labor, the canal widens to let the baby through.

- Cervix is the thick, round end of the uterus, which has an opening for menstrual blood to flow out and for a baby to be delivered. The cervix is usually a good barrier against bacteria, except around the time an egg is released by the ovaries, during the menstrual period, or during labor. Bacteria that cause sexually transmitted diseases can enter the uterus through the cervix during sexual intercourse.
- Ovaries are a pair of organs that make eggs and female hormones such as estrogen. The ovaries are usually pearl-colored, oblong, and about the size of a walnut. They are attached to the uterus by ligaments.
- Fallopian tubes are the tubes through which eggs pass from the ovaries to the uterus. The two fallopian tubes, which are about 4 to 5 inches (about 10 to 13 centimeters) long, extend from the upper edges of the uterus toward the ovaries. The tubes do not directly connect with the ovaries. Instead, the end of each tube flares into a funnel shape with fingerlike extensions.

The Female Menstrual Cycle

- Follicular (before release of the egg)
- Ovulatory (egg release)
- Luteal (after egg release)



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Menstruation is the shedding of the lining of the uterus called the endometrium and is accompanied by bleeding. It occurs in approximately monthly cycles throughout a woman's reproductive life, except during pregnancy. Menstruation starts during puberty and stops permanently at menopause.

By definition, the menstrual cycle begins with the first day of bleeding, which is counted as day 1. The cycle ends just before the next menstrual period, about 25 to 36 days.

The endometrial cycle is the portion within the

menstrual cycle that has to do with the endometrium. It helps the body prepare for pregnancy, and usually, consists of three phases

The first phase or the follicular phase starts before the release of the egg. When the follicular phase begins, the levels of estrogen and progesterone are low. As a result, the top layers of the thickened lining of the uterus break down and are shed, and menstrual bleeding occurs.

Next, the second phase is the ovulatory phase when the egg is released. The ovulatory phase usually lasts 16 to 32 hours, ending when the egg is released. The egg can be fertilized for only up to about 12 hours after its release. Egg release does not alternate between the two ovaries and appears to be random. So, even if one ovary is removed, the remaining ovary releases an egg every month.

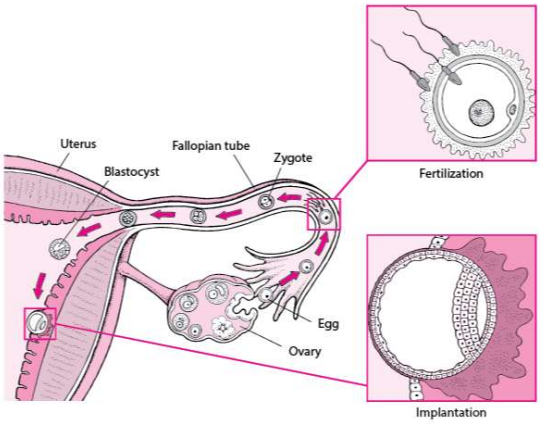
Lastly, the third phase or the Luteal phase arrives after the egg is released. In this phase, the ruptured follicle closes after releasing the egg and forms a structure called a corpus luteum which prepares the uterus in case an embryo is implanted, causes the endometrium to thicken, filling with fluids and nutrients to nourish a potential embryo, and causes the mucus in the cervix to thicken, so that sperm or bacteria are less likely to enter

the uterus

Now, do you know what happens when the egg is not fertilized or if the fertilized egg does not implant? Well, the egg moves down the fallopian tube to the uterus, where it degenerates, and passes through the uterus with the next menstrual period. And the corpus luteum degenerates after 14 days and a new menstrual cycle begins.

FERTILIZATION | EGG TO EMBRYO

- Blastocyst
- Placenta
- Amniotic Sac
- Embryo



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At ovulation, the mucus in the cervix becomes more fluid and more elastic, allowing the sperm to enter the uterus rapidly. Within 5 minutes, the sperm may move from the vagina, through the cervix into the uterus, and to the funnel-shaped end of a fallopian tube, which is the usual site of fertilization. The cells lining the fallopian tube facilitate fertilization.

If a sperm penetrates the egg, fertilization results. Tiny hairlike cilia lining the fallopian tube propel the fertilized egg, called zygote, through the tube toward the uterus. The cells of the zygote divide repeatedly as the zygote

moves down the fallopian tube to the uterus. The zygote enters the uterus in 3 to 5 days.

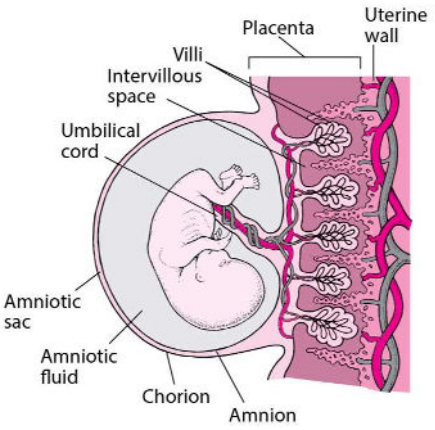
About 6 days after fertilization, the blastocyst attaches to the lining of the uterus, usually near the top. This process, called implantation, is completed by day 9 or 10.

The wall of the blastocyst is one cell thick except in one area, where it is three to four cells thick. The inner cells in the thickened area develop into the embryo, and the outer cells burrow into the wall of the uterus and develop into the placenta.

Some of the cells from the placenta develop into an outer layer of membranes called the chorion around the developing blastocyst. Other cells develop into an inner layer of membranes, which form the amniotic sac. When the sac is formed around day 11, the blastocyst is considered an embryo. The amniotic sac fills with a clear liquid (amniotic fluid) and expands to envelop the developing embryo, which floats within it.

Pregnancy | Embryo to Fetus

- Embryo Development
- Fetus
- Placenta
- Amniotic Sac



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The next stage in the development is the embryo, which develops within the amniotic sac, under the lining of the uterus on one side. This stage is characterized by the formation of most internal organs and external body structures. Most organs begin to form about 3 weeks after fertilization.

Almost all organs are completely formed by about 10 weeks after fertilization. The exceptions are the brain and spinal cord, which continue to form and develop throughout pregnancy. Most birth defects occur during the period when organs are forming.

About 6 weeks after fertilization, the placenta forms tiny hairlike projections called villi that extend into the wall of the uterus. Blood vessels from the embryo, which pass through the umbilical cord to the placenta, develop in the villi.

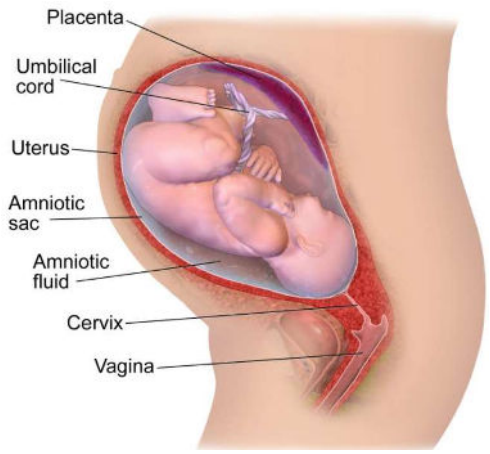
A thin membrane separates the embryo's blood in the villi from the mother's blood that flows through the space surrounding the villi, and this is called the intervillous space. This allows materials to be exchanged between the blood of the mother and that of the embryo. And it Prevents the mother's immune system from attacking the embryo because the mother's antibodies are too large to pass through the membrane.

The umbilical cord grows out of the other side of the placenta. The cord connects the embryo to the placenta. Blood from the embryo circulates through the cord into the placenta, and in the placenta, the embryo's blood picks up oxygen and nourishment.

The embryo floats in the amniotic fluid, which is contained in the amniotic sac. This amniotic fluid provides a space in which the embryo can grow freely and protects the embryo from injury.

Development of the Fetus

- 10 Weeks: Embryo becomes a Fetus
- 12 Weeks: Fetus fills Uterus
- 14 Weeks: Sex may be identified
- 16-20 weeks: Feeling movement
- 24 weeks: Fetus may be viable outside the womb



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At the end of the 8th week after fertilization, or about 10 weeks of pregnancy, the embryo is considered a fetus. During this stage, the structures that have already formed, start to grow and develop. The following are the markers during pregnancy:

By 12 weeks of pregnancy, the fetus fills the entire uterus.

By about 14 weeks, the sex can be identified.

By about 16 to 20 weeks, the pregnant woman can feel the fetus moving. Women who have been pregnant

before typically feel movements about 2 weeks earlier than women who are pregnant for the first time.

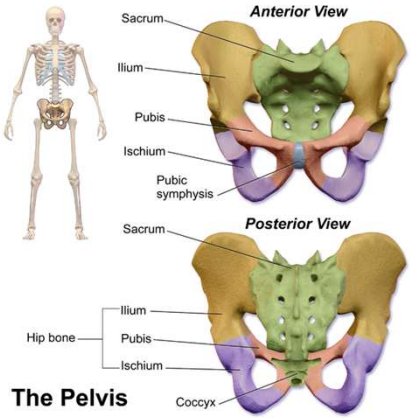
By about 24 weeks, the fetus has a chance of survival outside the uterus.

The lungs continue to mature until near the time of delivery. The brain accumulates new cells throughout pregnancy and the first year of life after birth.

Note that anything ingested by a pregnant woman has the potential to affect the fetus.

Female Anatomy | Reproductive Adaptations

- Suited to accommodate the fetus
- Pelvic Shape – 4 types
- Pelvic Girdle
- Pelvic Floor



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The female anatomy is tailored to the human reproductive needs. The specific adaptations are as follows.

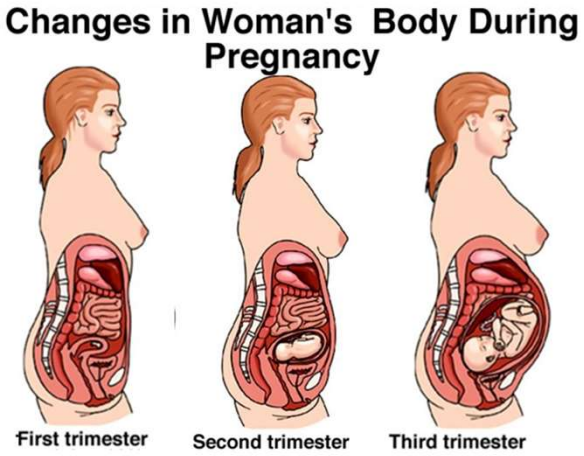
- In females, the pelvis region, found between the trunk and lower limbs, is wider and lower than that of their male counterpart. Hence, making it more suited to accommodate a fetus during both pregnancy and delivery. This area includes the Uterus, Ovaries, Fallopian tubes and Cervix.
- While pelvis shape can vary widely among females, there are four general types. The pelvis shape may

affect if birth can be accommodated vaginally. The gynecoid pelvis is the most common pelvis shape in females and is favorable for a vaginal birth.

- The pelvic girdle is a complex ring of joints, ligaments, and muscles. The three main bones of this region, two ilium and the sacrum, meet to form three joints. These joints are supported by some of the strongest ligaments in the body which become more lax during pregnancy, leading to increased joint mobility and less efficient load transfer.
- The pelvic floor muscles are a group of muscles that run from the tip of the pubic bone to the tailbone. They are comprised of several layers of musculature and serve several important functions for the lower back and the sacroiliac joint, besides providing bladder control.

Female Anatomy | Pregnancy Changes

- Placenta Development
- Uterus
- Cervical Tip Softening
- Vaginal Mucosa
- Cardiac Output



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Pregnancy and its changes is a normal physiological process that happens in all mammalians, in response to the development of the fetus. These changes happen in response to many factors such as hormonal changes, an increase in the total blood volume, weight gain, and an increase in fetus size. All these factors have a physiological impact on all systems of the pregnant woman including musculoskeletal, endocrine, reproductive system, cardiovascular, respiratory, gastrointestinal system, and renal changes.

Increases in blood sugar, breathing, and cardiac output

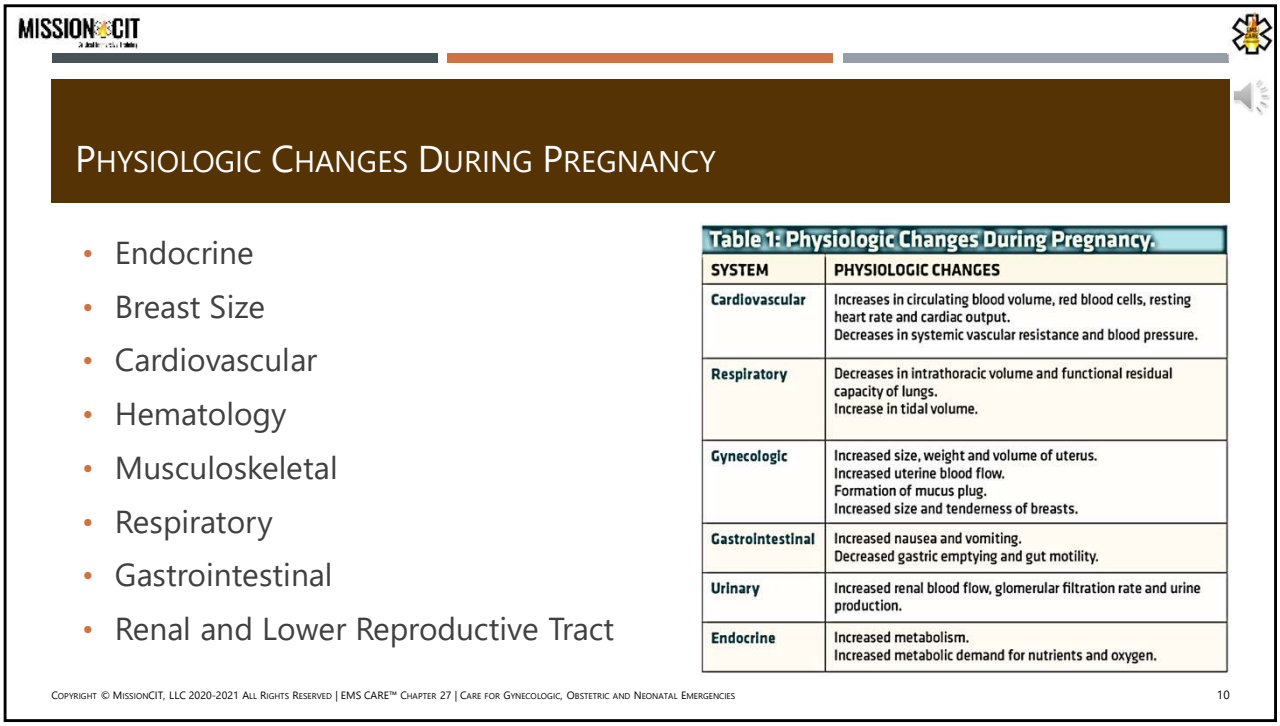
are all expected changes that allow a pregnant woman's body to facilitate the proper growth and development of the embryo or fetus during the pregnancy. The pregnant woman and the placenta also produce many other hormones that have a broad range of effects during the pregnancy.

The reproductive system changes during pregnancy include:

- The development of the placenta
- Increase in the size of the uterus along with the abdominal extension, weight gain, breast enlargement, and some postural changes. The uterus not only increases in size, but also changes its position and shape. The muscular wall of the uterus strengthens and becomes more elastic.
- The softening of the cervical tip at the beginning of the sixth week may be observed.
- The vaginal mucosa also becomes thick and prepares itself for stretching during labor and birth.
- All the systems of the body like respiratory, cardiovascular, renal, Gastrointestinal tract, musculoskeletal, and integumentary adapt themselves to provide for maternal and fetal needs.

- Cardiac output increases from 30% to 50% over the non-pregnant rate.
- The breasts produce milk that is carried through small ducts to the nipple to provide nourishment to the newborn once it is born.

Notably, almost all of these changes and adaptations revert to the non-pregnant state after birth and lactation.



The diagram illustrates some of the specific physiological changes that generally occur during pregnancy. Some high-level changes to expect are as follows:

- Pregnant women experience changes in their endocrine system that help support the developing

fetus, thereby altering the function of various maternal endocrine glands. Sometimes, the changes in certain hormone levels and their effects on their target organs can lead to gestational diabetes and gestational hypertension.

- Neuromechanical adaptations to pregnancy refer to the change in gait, posture, as well as the sensory feedback. These changes increase their risk of musculoskeletal disorders and fall injuries.
- Lung Volume changes include decreased functional residual capacity of up to 25% and an

increase in the tidal volume of 30-50%. There is increasing edema in the upper airway tract.

- Breast Size: A woman's breasts grow during pregnancy, usually 1 to 2 cup sizes. A woman's torso also grows, and her bra band size may increase one or two sizes.
- During pregnancy, the plasma volume increases by 40-50%. Hence, a pregnant woman will also become hypercoagulable, leading to increased risk for developing blood clots and embolisms, such as deep vein thrombosis and pulmonary embolism.
- A pregnant woman may

experience an increase in the size of the kidneys and ureter due to the increased blood volume. In the third trimester, when the fetus starts to engage in the pelvis, there is an increased frequency of urination.

So, that is the end of this lesson, the Anatomy, and Physiology of the Female Reproductive System. Justin will be with you next to discuss labor and patient assessment.

Good Studying.