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COURSE TITLE: ENDOCRINE PHYSIOLOGY

Discuss lactation and gestation period in a normal female

LACTATION

Lactation describes the secretion of [milk](https://en.wikipedia.org/wiki/Milk%22%20%5Co%20%22Milk) from the [mammary glands](https://en.wikipedia.org/wiki/Mammary_gland%22%20%5Co%20%22Mammary%20gland) and the period of time that a [mother](https://en.wikipedia.org/wiki/Mother%22%20%5Co%20%22Mother) lactates to feed her young. The process naturally occurs with all post-[pregnancy](https://en.wikipedia.org/wiki/Pregnancy%22%20%5Co%20%22Pregnancy) [female mammals](https://en.wikipedia.org/wiki/Female_mammals%22%20%5Co%20%22Female%20mammals), although it predates mammals. In humans the process of feeding milk is also called [breastfeeding](https://en.wikipedia.org/wiki/Breastfeeding%22%20%5Co%20%22Breastfeeding) or nursing. From the eighteenth week of [pregnancy](https://en.wikipedia.org/wiki/Pregnancy%22%20%5Co%20%22Pregnancy) (the second and third [trimesters](https://en.wikipedia.org/wiki/Physiology_of_pregnancy%22%20%5Co%20%22Physiology%20of%20pregnancy)), a woman's body produces [hormones](https://en.wikipedia.org/wiki/Hormone%22%20%5Co%20%22Hormone) that stimulate the growth of the [milk duct](https://en.wikipedia.org/wiki/Milk_duct%22%20%5Co%20%22Milk%20duct) system in the [breasts](https://en.wikipedia.org/wiki/Breast%22%20%5Co%20%22Breast):

1. [Progesterone](https://en.wikipedia.org/wiki/Progesterone) influences the growth in size of [alveoli](https://en.wikipedia.org/wiki/Alveolar_gland%22%20%5Co%20%22Alveolar%20gland) and lobes; high levels of progesterone inhibit lactation before birth. Progesterone levels drop after birth; this triggers the onset of copious milk production.
2. [Estrogen](https://en.wikipedia.org/wiki/Estrogen) stimulates the milk duct system to grow and differentiate. Like progesterone, high levels of estrogen also inhibit lactation. Estrogen levels also drop at delivery and remain low for the first several months of breastfeeding. Breastfeeding mothers should avoid estrogen-based birth control methods, as a spike in estrogen levels may reduce a mother's milk supply.
3. [Prolactin](https://en.wikipedia.org/wiki/Prolactin) contributes to the increased growth and differentiation of the alveoli, and also influences differentiation of ductal structures. High levels of prolactin during pregnancy and breastfeeding also increase insulin resistance, increase growth factor levels (IGF-1) and modify lipid metabolism in preparation for breastfeeding. During lactation, prolactin is the main factor maintaining [tight junctions](https://en.wikipedia.org/wiki/Tight_junction%22%20%5Co%20%22Tight%20junction) of the ductal epithelium and regulating milk production through osmotic balance. [Human placental lactogen](https://en.wikipedia.org/wiki/Human_placental_lactogen) (HPL) – from the second month of pregnancy, the [placenta](https://en.wikipedia.org/wiki/Placenta%22%20%5Co%20%22Placenta) releases large amounts of HPL. This hormone is closely associated with prolactin and appears to be instrumental in breast, nipple, and areola growth before birth.
4. [Follicle stimulating hormone](https://en.wikipedia.org/wiki/Follicle_stimulating_hormone) (FSH), [luteinizing hormone](https://en.wikipedia.org/wiki/Luteinizing_hormone%22%20%5Co%20%22Luteinizing%20hormone) (LH), and [human chorionic gonadotropin](https://en.wikipedia.org/wiki/Human_chorionic_gonadotropin%22%20%5Co%20%22Human%20chorionic%20gonadotropin) (hCG), through control of estrogen and progesterone production, and also, by extension, prolactin and growth hormone production, are essential.
5. [Growth hormone](https://en.wikipedia.org/wiki/Growth_hormone) (GH) is structurally very similar to prolactin and independently contributes to its galactopoiesis.
6. [Adrenocorticotropic hormone](https://en.wikipedia.org/wiki/Adrenocorticotropic_hormone) (ACTH) and [glucocorticoids](https://en.wikipedia.org/wiki/Glucocorticoid%22%20%5Co%20%22Glucocorticoid) such as [cortisol](https://en.wikipedia.org/wiki/Cortisol%22%20%5Co%20%22Cortisol) have an important lactation inducing function in several animal species, including humans. Glucocorticoids play a complex regulating role in the maintenance of tight junctions.
7. [Thyroid-stimulating hormone](https://en.wikipedia.org/wiki/Thyroid-stimulating_hormone) (TSH) and [thyrotropin-releasing hormone](https://en.wikipedia.org/wiki/Thyrotropin-releasing_hormone%22%20%5Co%20%22Thyrotropin-releasing%20hormone) (TRH) are very important galactopoietic hormones whose levels are naturally increased during pregnancy.
8. [Oxytocin](https://en.wikipedia.org/wiki/Oxytocin) contracts the [smooth muscle](https://en.wikipedia.org/wiki/Smooth_muscle%22%20%5Co%20%22Smooth%20muscle) of the [uterus](https://en.wikipedia.org/wiki/Uterus%22%20%5Co%20%22Uterus) during and after birth, and during orgasm(s). After birth, oxytocin contracts the smooth muscle layer of band-like cells surrounding the alveoli to squeeze the newly produced milk into the duct system. Oxytocin is necessary for the milk ejection reflex, or let-down, in response to suckling, to occur.

It is also possible to [induce lactation](https://en.wikipedia.org/wiki/Lactation%22%20%5Cl%20%22Lactation_without_pregnancy%2C_induced_lactation%2C_relactation) without pregnancy. Protocols for inducing lactation are called the Goldfarb protocols. Using birth control pills to mimic the hormone levels of pregnancy, then discontinuing the birth control, followed by use of a double electric breast pump for 15 minute sessions at regular 2-3 hour intervals (100+ minutes total per day) helps to induce milk production.

SECRETORY ACTIVATION

At [birth](https://en.wikipedia.org/wiki/Childbirth%22%20%5Co%20%22Childbirth), prolactin levels remain high, while the delivery of the placenta results in a sudden drop in progesterone, estrogen, and HPL levels. This abrupt withdrawal of progesterone in the presence of high prolactin levels stimulates the copious milk production of Secretory Activation. When the breast is stimulated, prolactin levels in the blood rise, peak in about 45 minutes, and return to the pre-breastfeeding state about three hours later. The release of prolactin triggers the cells in the alveoli to make milk. Prolactin also transfers to the breast milk. Some research indicates that prolactin in milk is greater at times of higher milk production, and lower when breasts are fuller, and that the highest levels tend to occur between 2 a.m. and 6 a.m.

Other hormones—notably insulin, thyroxine, and cortisol—are also involved, but their roles are not yet well understood. Although biochemical markers indicate that Secretory Activation begins about 30–40 hours after birth, mothers do not typically begin feeling increased breast fullness (the sensation of milk "coming in the breast") until 50–73 hours (2–3 days) after birth. [Colostrum](https://en.wikipedia.org/wiki/Colostrum) is the first milk a breastfed baby receives. It contains higher amounts of white blood cells and [antibodies](https://en.wikipedia.org/wiki/Antibody%22%20%5Co%20%22Antibody) than mature milk, and is especially high in [immunoglobulin A](https://en.wikipedia.org/wiki/Immunoglobulin_A%22%20%5Co%20%22Immunoglobulin%20A) (IgA), which coats the lining of the baby's immature intestines, and helps to prevent pathogens from invading the baby's system. Secretory IgA also helps prevent food allergies. Over the first two weeks after the birth, colostrum production slowly gives way to mature breast milk.

GESTATION

 Gestation is the period of development during the carrying of an embryo or fetus inside viviparous animals. It is typical for [mammals](https://en.wikipedia.org/wiki/Mammal), but also occurs for some non-mammals. [Mammals during pregnancy](https://en.wikipedia.org/wiki/Pregnancy_%28mammals%29) can have one or more gestations at the same time, for example in a [multiple birth](https://en.wikipedia.org/wiki/Multiple_birth). The time interval of a gestation is called the [gestation period](https://en.wikipedia.org/wiki/Gestation_period). Human pregnancy can be divided roughly into three trimesters, each approximately three months long. The first trimester is from the last period through the 13th week, the second trimester is 14th–27th week, and the third trimester is 28th–42nd week. Birth normally occurs at a [gestational age](https://en.wikipedia.org/wiki/Gestational_age) of about 40 weeks, though it is common for births to occur from 37 to 42 weeks. From the 9th week of pregnancy (11th week of [gestational age](https://en.wikipedia.org/wiki/Gestational_age)), the embryo is called a fetus. Various factors can come into play in determining the duration of gestation. For humans, male fetuses normally gestate several days longer than females and [multiple pregnancies](https://en.wikipedia.org/wiki/Multiple_birth) gestate for a shorter period.

PREGNANCY

Pregnancy, also known as gestation, is the time during which one or more [offspring](https://en.wikipedia.org/wiki/Offspring) develops inside a [woman](https://en.wikipedia.org/wiki/Woman). A [multiple pregnancy](https://en.wikipedia.org/wiki/Multiple_birth) involves more than one offspring, such as with [twins](https://en.wikipedia.org/wiki/Twin). Pregnancy can occur by [sexual intercourse](https://en.wikipedia.org/wiki/Sexual_intercourse) or [assisted reproductive technology](https://en.wikipedia.org/wiki/Assisted_reproductive_technology). A pregnancy may end in a [live birth](https://en.wikipedia.org/wiki/Live_birth_%28human%29), [miscarriage](https://en.wikipedia.org/wiki/Miscarriage), or [abortion](https://en.wikipedia.org/wiki/Abortion). [Childbirth](https://en.wikipedia.org/wiki/Childbirth) typically occurs around 40 weeks from the start of the [last menstrual period](https://en.wikipedia.org/wiki/Menstruation#Onset_and_frequency) (LMP). This is just over nine [months](https://en.wikipedia.org/wiki/Months), where each month averages 31 days. When measured from [fertilization](https://en.wikipedia.org/wiki/Fertilization) it is about 38 weeks. An [embryo](https://en.wikipedia.org/wiki/Embryo) is the developing offspring during the first eight weeks following fertilization, after which, the term [fetus](https://en.wikipedia.org/wiki/Fetus) is used until birth. Symptoms of early pregnancy may include [missed periods](https://en.wikipedia.org/wiki/Amenorrhea), tender breasts, [nausea and vomiting](https://en.wikipedia.org/wiki/Morning_sickness), hunger, and frequent urination. Pregnancy may be confirmed with a [pregnancy test](https://en.wikipedia.org/wiki/Pregnancy_test).

Pregnancy is divided into three trimesters, each lasting for approximately 3 months. The [first trimester](https://en.wikipedia.org/wiki/First_trimester) includes conception, which is when the sperm fertilizes the egg. The [fertilized egg](https://en.wikipedia.org/wiki/Zygote) then travels down the [fallopian tube](https://en.wikipedia.org/wiki/Fallopian_tube) and attaches to the inside of the [uterus](https://en.wikipedia.org/wiki/Uterus), where it begins to form the [embryo](https://en.wikipedia.org/wiki/Embryo) and [placenta](https://en.wikipedia.org/wiki/Placenta). During the first trimester, the possibility of [miscarriage](https://en.wikipedia.org/wiki/Miscarriage) (natural death of embryo or fetus) is at its highest. Around the middle of the second trimester, movement of the fetus may be felt. At 28 weeks, more than 90% of babies can [survive outside of the uterus](https://en.wikipedia.org/wiki/Fetal_viability) if provided with high-quality medical care.

[Prenatal care](https://en.wikipedia.org/wiki/Prenatal_care) improves pregnancy outcomes. Prenatal care may include taking extra [folic acid](https://en.wikipedia.org/wiki/Folic_acid), avoiding drugs and alcohol, regular exercise, blood tests, and regular [physical examinations](https://en.wikipedia.org/wiki/Physical_examination). [Complications of pregnancy](https://en.wikipedia.org/wiki/Complications_of_pregnancy) may include [disorders of high blood pressure](https://en.wikipedia.org/wiki/Hypertensive_disease_of_pregnancy), [gestational diabetes](https://en.wikipedia.org/wiki/Gestational_diabetes), [iron-deficiency anemia](https://en.wikipedia.org/wiki/Iron-deficiency_anemia), and [severe nausea and vomiting](https://en.wikipedia.org/wiki/Hyperemesis_gravidarum) among others. In the ideal childbirth labor begins on its own when a woman is "at term".Babies born before 37 weeks are "[preterm](https://en.wikipedia.org/wiki/Preterm)" and at higher risk of health problems such as [cerebral palsy](https://en.wikipedia.org/wiki/Cerebral_palsy). Babies born between weeks 37 and 39 are considered "early term" while those born between weeks 39 and 41 are considered "full term".Babies born between weeks 41 and 42 weeks are considered "late term" while after 42 week they are considered "[post term](https://en.wikipedia.org/wiki/Postterm_pregnancy)".[Delivery](https://en.wikipedia.org/wiki/Childbirth) before 39 weeks by [labor induction](https://en.wikipedia.org/wiki/Labor_induction) or [caesarean section](https://en.wikipedia.org/wiki/Caesarean_section) is not recommended unless required for other medical reasons.