

General Outcome 3

Students will explain how cell differentiation and development in the human organism are regulated by a combination of genetic, endocrine and environmental factors.

30-B3.1k trace the processes of fertilization, implantation and extra-embryonic membrane formation, i.e., placenta, amnion, chorion, allantois, followed by embryonic and fetal development, parturition and lactation, and describe the control mechanisms of these events, i.e., progesterone, LH, human chorionic gonadotropin (hCG), prostaglandins, oxytocin, prolactin

30-B3.2k describe development from fertilization to parturition in the context of the main physiological events that occur in the development of organ systems during each major stage (trimester); i.e., zygote, blastocyst, gastrulation, general morphogenesis

30-B3.3k identify major tissues and organs that arise from differentiation and morphological development of the ectoderm, mesoderm and endoderm in the embryo; i.e.,

ectoderm: nervous system, epidermis

mesoderm: skeleton, muscles, reproductive structures

endoderm: lining of the digestive and respiratory systems, endocrine glands

30-B3.4k describe the influence of environmental factors on embryonic and fetal development; *e.g., maternal lifestyle, teratogens such as alcohol, drugs, viral infections and radiation*

30-B3.5k describe the physiological or mechanical basis of different reproductive technologies; i.e., conception control, in vitro fertilization, infertility reversal.

30-B1.1s formulate questions about observed relationships and plan investigations of questions, ideas, problems and issues

identify ethical concerns about reproductive technologies, infertility and the transmission of STIs (IP-SEC1).

30-B3.1sts explain that science and technology are developed to meet societal needs and expand human capability (SEC1)

analyze the use of technology to solve problems of immunological incompatibility between fetus and mother

30-B3.2sts explain why decisions regarding the application of scientific and technological development involve a variety of perspectives, including social, cultural, environmental, ethical and economic considerations (SEC4b)

assess the use of technologies such as ultrasound, chorionic villus sampling (CVS), amniocentesis and a fetal heart rate monitor in monitoring fetal development

assess the effects of a conception control technology on population demographics in developed and developing countries

discuss how knowledge of embryonic/fetal development has influenced the value that society places on human life

discuss the societal impact of environmental contaminants (such as polychlorinated biphenyls [PCBs], heavy metals, dioxins and furans) and teratogens

30-B3.2s conduct investigations into relationships between and among observable variables and use a broad range of tools and techniques to gather and record data and information

investigate, using library and electronic sources, the effects of environmental factors on human embryonic and fetal development; e.g., alcohol, cocaine, cigarette smoke, diet, and prescription and nonprescription drugs

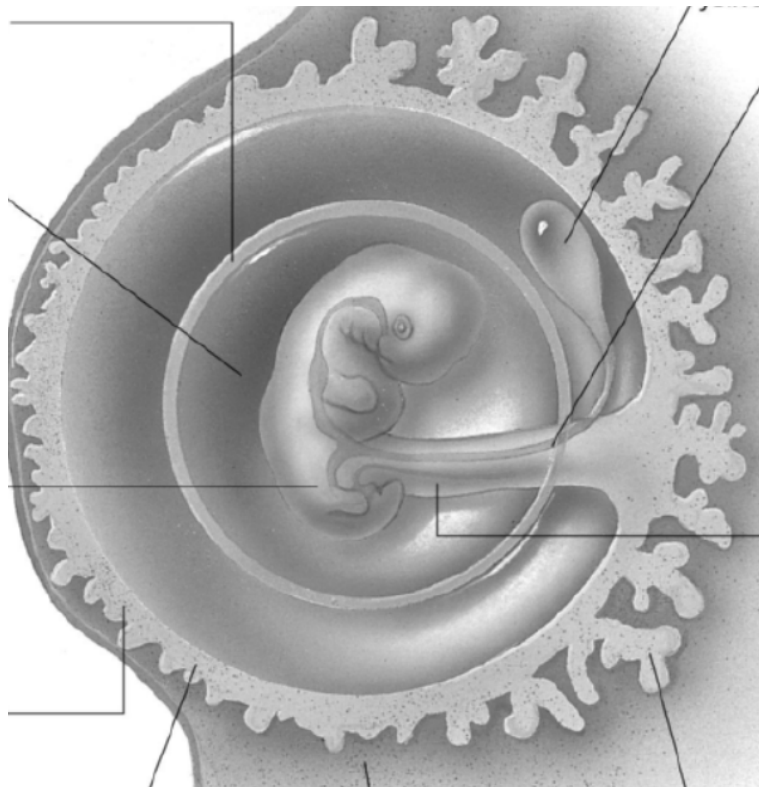
research the societal impact of technology such as ultrasound, amniocentesis, in vitro fertilization and CVS

Outcome 2

Class 1 – Fertilization and Implantation

Pre-Class Reading Assignment

1. Read pgs 530-531
2. Define the following terms
 - a. Zygote
 - b. Cleavage
 - c. Blastocyst
 - d. Implantation
 - e. Chorion
 - f. Amnion
 - g. Allantois
 - h. placenta
 - i. hCG
 - j. umbilical cord
3. Label the following diagram



Outcome 2
Class 1 – Fertilization and Implantation
Notes

<http://owensborohealthse3.adam.com/content.aspx?productid=147&Category=NineMonthMiracleVideo>

- 150-300million sperm reach the uterus but only a few hundred make the oviducts, and only one makes it into the egg

- Fertilized egg is now called a **zygote**

- **Cleavage** involves equal divisions of the cells of the zygote without any increase in size

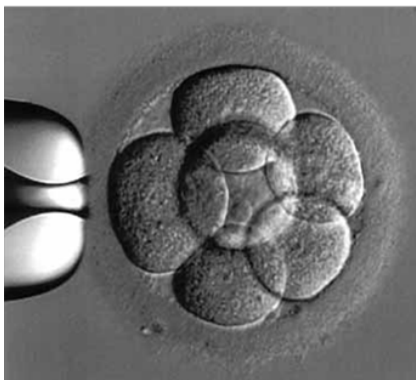
- As a result, the cells of the zygote become progressively smaller with each division

- As the zygote travels to the uterus, it begins cell division and becomes a **blastocyst**

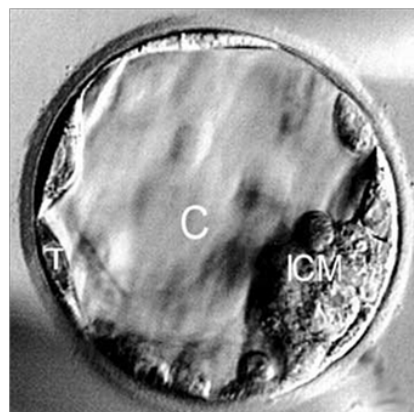
- consists of an outer sphere of cells, from which the extraembryonic structures develop, and an inner cell mass, from which the embryo develops

- The blastocyst attached to the wall of the endometrium, a process known as implantation

Day 3

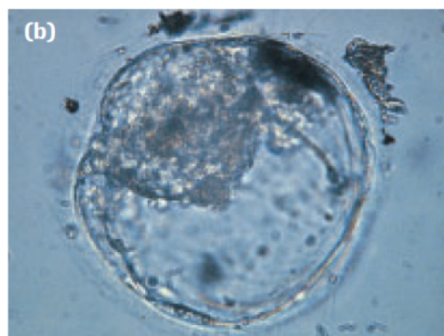
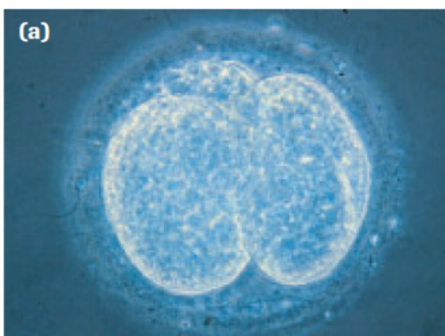


Blastocyst (~day 6)



The cells which will become the fetus are in the area marked as "ICM" (inner cell mass)

The trophoblast, cells that will form the placenta surround the cavity - one is marked with a "T"





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Fertilization Video

https://www.youtube.com/watch?v=_5OvgQW6FG4



[ps://www.youtube.com/watch?v=BFrVmDgh4v4](https://www.youtube.com/watch?v=BFrVmDgh4v4)

Changes to the Woman's Body to support pregnancy

- Developing baby goes through different stages
 - o Zygote (0-3 days) – in oviduct
 - o Blastocyst (4-6 days) – travel from oviduct and implants in uterus
 - o Embryo (4-60 days) – in uterus
 - o Fetus (60 days-birth) – in uterus
- Menstruation cannot occur
 - o Shedding the endometrial lining would dislodge the embryo
- Embryo secretes human chorionic gonadotropic (hCG) hormone (after implantaion)
 - o maintains the corpus luteum for the first three months of pregnancy
 - o the functioning corpus luteum continues producing progesterone and estrogen, which in turn maintain the endometrium.
 - o The endometrium and embryo thus remain in the uterus.
- Pregnancy tests identify hCG levels in the urine of women
- Cells from the embryo and endometrium combine to form the placenta, through which materials are exchanged between the mother and developing embryo.
- At approximately the fourth month of pregnancy, the placenta begins to produce estrogen and progesterone. High levels of progesterone prevent further ovulation

Multiple Births**Identical multiple births**

- Result from a single fertilized egg or zygote splitting into two or more embryos, each carrying the same genetic material (genes).

Fraternal multiple births

- result from multiple ova being ripened and released in the same menstrual cycle by a woman's ovaries
- fertilized to grow into multiples no more genetically alike than ordinary full siblings

Triplets

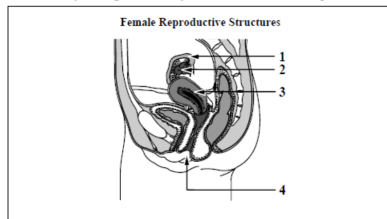
- a set of triplets may be composed of
 - o identical triplets (one egg)
 - a single fertilized egg splits in two and then one of the resulting two eggs splits again
 - o identical twins from one egg and a third sibling from a second egg
 - o three fraternal siblings (three eggs)

Birth Control Pill

- Combined Oral Contraceptive Pill (COCP), often referred to as “the Pill”
- Contain progesterone and estrogen
 - o Suppress FSH release by the pituitary
 - o No FSH = No ovulation
 - o No ovulation = no egg
 - o No egg = no baby
- Also decreases the amount of and increasing the viscosity of the cervical mucus
 - o This inhibits sperm penetration through the cervix into the uterus and oviduct

Outcome 2
Class 1 - Fertilization and Implantation
Review Assignment

Use the following additional information to answer the next question.



Some contraceptives, such as condoms, prevent fertilization. Fertilization usually occurs in the structure labelled

- A. 1
- B. 2
- C. 3
- D. 4

Another contraceptive, the birth control pill, causes negative feedback on the pituitary, which prevents the release of eggs. Typically, the hormones in the birth control pill are similar to

- A. FSH and LH
- B. oxytocin and prolactin
- C. estrogen and progesterone
- D. relaxin and gonadotropins

During the first three days of development, the human embryo obtains nutrients and energy from the

- A. HCG
- B. amniotic fluid
- C. trophoblast of the mother's egg
- D. mitochondria of the father's sperm

The presence of a particular hormone in urine indicates that pregnancy has occurred. This hormone is secreted by the

- A. ovary
- B. amnion
- C. chorion
- D. placenta

Use the following information to answer the next question.

Researchers have developed a birth control vaccine that would be given once a year. This vaccine is made from a fragment of HCG attached to a protein. The vaccine causes a woman to manufacture antibodies that bind to HCG molecules (when present) in the blood. The antibodies prevent HCG from functioning and thereby affect the implantation of a blastocyst (embryo).

The vaccine affects the permanent implantation of a blastocyst by indirectly causing

- A. disintegration of the endometrium
- B. increased progesterone production
- C. development of new follicles in the ovary
- D. inhibition of the movement of cilia in the Fallopian tubes

Use the following information to answer the next question.

Reproductive Events in a Mature Human Female	
1	Ovulation
2	Placenta forms
3	Fertilization
4	Implantation

Numerical Response

1. The above events, in the sequence in which they occur before childbirth, are _____.

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

Answer: 1 3 4 2

Use the following information to answer the next question.

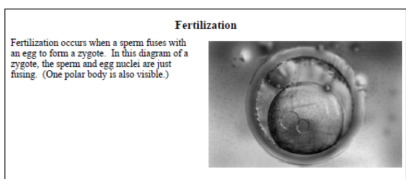
Some Events in the Human Reproductive Cycle	
1	Pre-embryo releases HCG, which maintains hormone levels
2	A hormone signals the follicle to rupture
3	Blastocyst is implanted
4	The egg is fertilized to form a zygote.

Numerical Response

2. The above events, in the sequence in which they occur during the reproductive cycle, are _____.

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

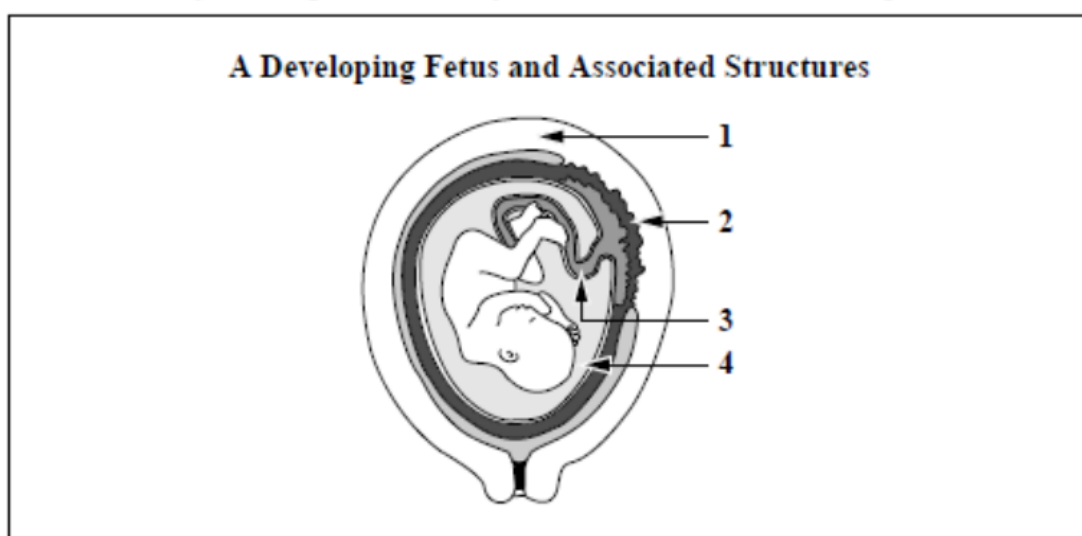
Answer: 2 4 3 1



The event depicted above normally occurs in the

- A. ovary
- B. uterus
- C. vagina
- D. Fallopian tube

Use the following additional information to answer the next question.



Progesterone and HCG, which are used to maintain the developing fetus, are both produced in the structure numbered

- A. 1
- B. 2
- C. 3
- D. 4

Outcome 2

Class 2 – Embryonic and Fetal Development (include sex determination – Y Chromosome)

Pre-Class Reading Assignment

1. Read pgs 532-534
2. Define the following terms
 - a. gastrulation
 - b. gastrula
 - c. endoderm
 - d. mesoderm
 - e. ectoderm
 - f. first trimester
 - g. second trimester
 - h. third trimester

Outcome 2

Class 2 – Embryonic and Fetal Development

Notes

https://www.msichicago.org/fileadmin/assets/online_science/games/make_room/v2/mrb.html

- Pregnancies last approx 9 months divided into 3 trimesters

- 1st trimester – 0-3 months
- 2nd trimester – 3-6 months
- 3rd trimester – 6-9 months

<http://owensborohealthse3.adam.com/content.aspx?productId=147&isArticleLink=false&pid=17&gid=000056&Category=Interactive%20Tool>

First Trimester <http://aia5.adam.com/content.aspx?productId=117&pid=1&gid=002398>

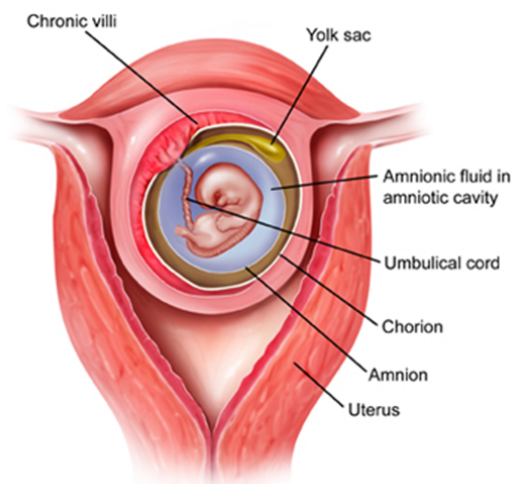
- Outer layer of blastocyst gives rise to two membranes

- **Chorion** – outer membrane of embryo
 - produces human **chorionic** gonadotropic hormone (HCG)
 - This hormone maintains the corpus luteum for the first 3 months of pregnancy
 - This is the hormone that pregnancy tests detect
- Amnion – inner membrane of embryo
 - Develops into a fluid filled sac
 - Insulates embryo, protects from infection, dehydration, impact and temp changes
 - http://www.pennmedicine.org/encyclopedia/em_DisplayAnimation.aspx?gcid=000130&ptid=17
 - It is the "water" when a woman's water breaks

- The **placenta** forms from cells of the endometrium and the embryo

- Blood capillaries of mother exchange waste and nutrients with capillaries from the fetus (**allantois**)
- The umbilical cord connects the fetus to the placenta
- In the 4th month of pregnancy, the placenta begins to produce estrogen and progesterone
- http://www.pennmedicine.org/encyclopedia/em_DisplayAnimation.aspx?gcid=000101&ptid=17

- **Yolk sac** forms below embryo and provides red blood cells

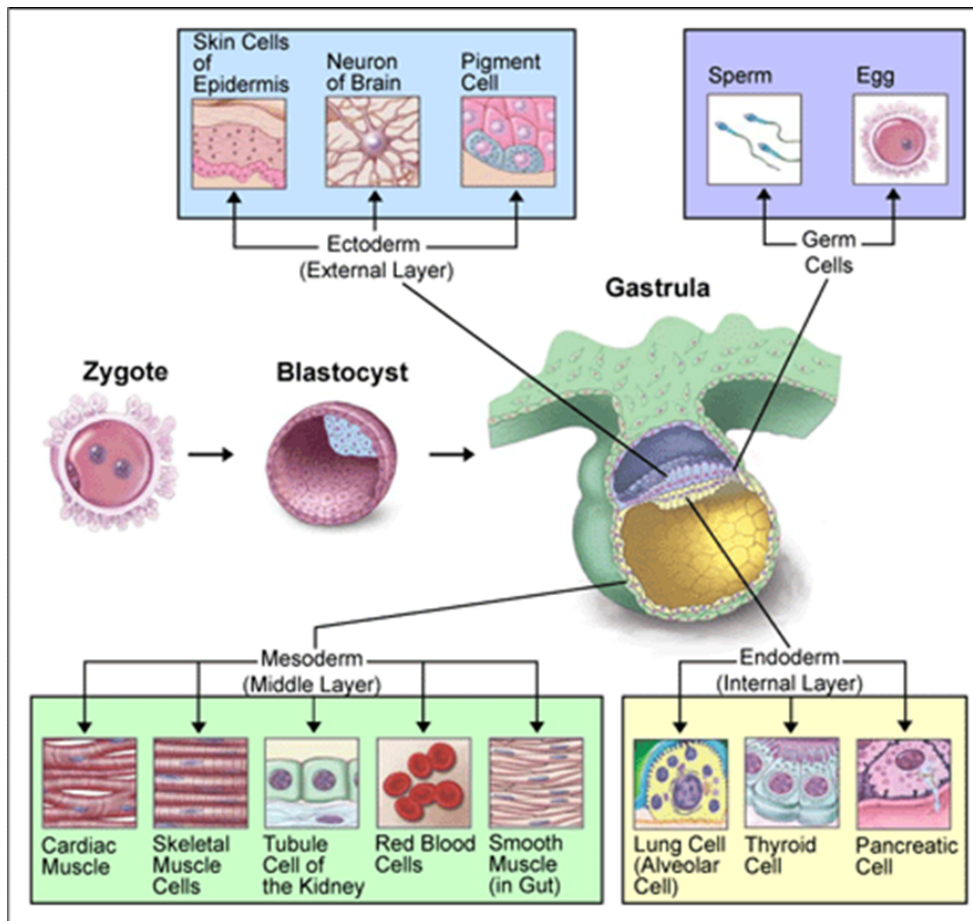


- At approximately week 3 gastrulation occurs forming 3 germ layers











http://wps.aw.com/bc_goodenough_boh_3/104/26722/6840911.cw/content/index.html

Table 1 Organs and Structures Arising from the Three Gastrula Layers

Gastrula layer	Structures
ectoderm	<ul style="list-style-type: none"> • skin, hair, finger nails, sweat glands • nervous system, brain, peripheral nerves • lens, retina, cornea • inner ear, cochlea, semicircular canals • teeth, inside lining of mouth
mesoderm	<ul style="list-style-type: none"> • muscles (skeletal, cardiac, and smooth) • blood vessels and blood • kidneys, reproductive structures • connective tissue, cartilage, bone
endoderm	<ul style="list-style-type: none"> • liver, pancreas, thyroid, parathyroid • urinary bladder • lining of digestive system • lining of respiratory tract



<https://www.youtube.com/watch?v=dgPCDXmcQJM>

First Trimester		
0-1.5 weeks	<ul style="list-style-type: none"> fertilization and early development formation of a viable zygote by the union of sperm and ovum; fertilization implantation normally positioned in the uterus 	
1.5 weeks	<ul style="list-style-type: none"> embryonic development begins amnion and yolk sac formed 	
2nd week	<ul style="list-style-type: none"> formation of primitive streak and primary germ layers 	
3rd week	<ul style="list-style-type: none"> central nervous system begins to develop heart development initiated; beating begins 	
4th week	<ul style="list-style-type: none"> about 1 cm long and weighs less than 1 g early eyes limb buds of arms and legs 	
5th week	<ul style="list-style-type: none"> nose and lips formation begins basic architecture of brain and spinal cord established 	
8th week	<ul style="list-style-type: none"> now about the size of a chicken's egg embryo 2 cm long and weighs about 4 g hands and feet seen baby extremely reactive to its environment male sex hormone (testosterone) produced by testes masculine development in males; no change in females 	
9th week	<ul style="list-style-type: none"> fetal development begins 	
12th week	<ul style="list-style-type: none"> embryo about the size of a goose egg placenta well-established and weighs more than the baby baby approximately 9 cm long and weighs about 60 g 	
Second Trimester		
14th-16th week	<ul style="list-style-type: none"> brain developed to the point that baby can suck, swallow, and make irregular breathing movements 	
16th week	<ul style="list-style-type: none"> 14 cm long and weighs 180 g complete closure of nasal septum and palate fetal heart beat heard with amplification fetal movement is recognized sex distinguishable now 	
20th week	<ul style="list-style-type: none"> 20 cm long and weighs 300 g fine hair covering over entire body; probably for protection of skin fetal heart beat heard: 120-160 beats per minute 	
Third Trimester		
28th week	<ul style="list-style-type: none"> baby can survive outside uterus if lungs capable of breathing 10 %-20 % survival if born at this time 35 cm long and weighs 1100 g 	
32nd week	<ul style="list-style-type: none"> maturing: 50 % survival if born at this time should turn to head down position 41 cm long, weighs 1680 g skin red and wrinkly 	
30th-34th week	<ul style="list-style-type: none"> baby the same size as placenta 	
36th week	<ul style="list-style-type: none"> 94 % survival rate if born at this age 46 cm long, weighs 2500 g some subcutaneous fat fingermails now at the tips of the fingers 	
40th week	<ul style="list-style-type: none"> full term: 51 cm long, weighs 3400 g 	

McGraw Hill Fetal Development and Risk

Weeks: [input field]
Type of Risk: [input field]

This animation presents the changes that occur during the development of a human fetus. This animation demonstrates the developmental stages during pregnancy at which the embryo or fetus is susceptible to negative impacts from dietary deficiencies or excesses. As

Risk Level:
 Low [green square]
 Moderate [yellow square]
 High [red square]

Weeks	1	2	3	4	5	6	8	16	38
CNS	Low	Low	Low	Low	Low	Low	Low	Low	Low
Heart	Low	Low	Low	Low	Low	Low	Low	Low	Low
Limbs	Low	Low	Low	Low	Low	Low	Low	Low	Low
Eyes	Low	Low	Low	Low	Low	Low	Low	Low	Low
Ears	Low	Low	Low	Low	Low	Low	Low	Low	Low
Palate	Low	Low	Low	Low	Low	Low	Low	Low	Low
Teeth	Low	Low	Low	Low	Low	Low	Low	Low	Low
Genitalia	Low	Low	Low	Low	Low	Low	Low	Low	Low

Play [pause icon] Audio [text icon]

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Sex Determination

- The sex of a baby is determined by the genetic makeup of the fetus

- Two X chromosomes = girl
- 1 X, 1 Y chromosome = boy

<https://www.youtube.com/watch?v=kMWxuF9YW38>

- SRY (sex determining region of the Y chromosome) gene is mainly responsible for causing the changes in the fetus

- Developing gonads become testis, instead of ovaries

<https://ghr.nlm.nih.gov/gene/SRY#normalfunction>

- Balance between testosterone and estrogen is important

- Boys produce more testosterone than estrogen
- Girls produce more estrogen than testosterone

- Environmental estrogens can affect developing fetus

Outcome 2

Class 2 – Embryonic and Fetal Development

Review Assignment

Use the following information to answer the next question.

Premature infants born at 24-weeks gestation face a wide spectrum of physiological problems.

These problems arise because prior to the third trimester of pregnancy, fetuses

- A. have organs that are underdeveloped
- B. have not yet begun cell specialization
- C. depend upon amniotic fluid for oxygen
- D. depend upon amniotic fluid for nutrients

Stages in Development

- 1 Fetus has a beating heart
- 2 Embryo differentiates into three layers (gastrulation)
- 3 Blastocyst implants in endometrium
- 4 Cleavage (mitosis) leads to a large number of cells without growth

Numerical Response

- 3.** The “guevedoces” embryonic and fetal development was normal except for their reproductive organs. Match each of the developmental stages numbered above with the time period in which it occurs, as given below.

Stage: _____
 Time Period: First week Second week Third week Fourth week and on

Which of the steps of human development occurs after chorion development?

- A. Fertilization
- B. Implantation
- C. Cleavage (division of the zygote by mitosis)
- D. Organogenesis (the formation of body organs and systems)

Outcome 2

Class 3 – Technology in monitoring fetal development/Effect of environmental contaminants on fetal development

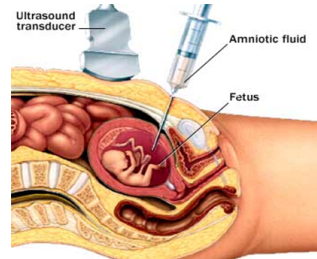
Notes

Monitoring Fetal Development <http://www.inova.org/blausen/mainLoader.swf>

Fetal Ultrasound - <http://www.youtube.com/watch?v=EIWj1NEQ9-E&feature=fvwrrel>

- What is it?
 - o an imaging technique that uses high-frequency sound waves to produce images of a baby in the uterus

- Reasons for:
 - o Confirm the pregnancy and its location.
 - o Determine your baby's gestational age.
 - o Confirm the number of babies.
 - o Evaluate your baby's growth.
 - o Study the placenta.
 - o Identify fetal abnormalities.
 - o Investigate signs or symptoms.
 - o Perform other prenatal tests.
 - o Determine fetal position before delivery.



- Risks:
 - o No risks identified
 - o Not 100% accurate

Amniocentesis - <http://www.yalemedicalgroup.org/stw/Page.asp?PageID=STW029252>

- What is it? <https://www.youtube.com/watch?v=bZcGpyOXt0>
 - o amniotic fluid is removed from the uterus for testing or treatment
 - o amniotic fluid contains fetal cells and chemicals produced by the baby
 - o can be used to test for Down syndrome and spina bifida

- Reasons for:
 - o You had abnormal results from a prenatal screening test.
 - o You had a chromosomal abnormality or a neural tube defect in a previous pregnancy.
 - o You're age 35 or older.
 - o You have a family history of a specific genetic disorder, or you or your partner is a known carrier of a genetic disorder.

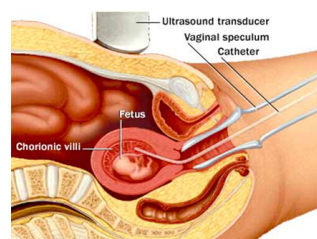
- Risks:
 - o Miscarriage - between 1 in 300 and 1 in 500.
 - o Cramping and vaginal bleeding.
 - o Needle injury.
 - o Leaking amniotic fluid.
 - o Rh sensitization.
 - o Infection. Rare
 - o Infection transmission - If you have an infection — such as hepatitis C, toxoplasmosis or human immunodeficiency virus — amniocentesis may cause transfer of the infection to your baby.

chorionic villus sampling (CVS) <http://www.muschealth.com/video/Default.aspx?videoId=10068&cId=34&type=rel>

- What is it?
 - o sample of chorionic villi is removed from the placenta for testing.

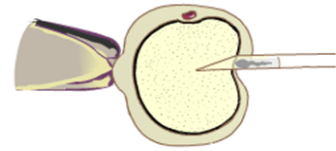
- Reasons for?
 - o Same as amniocentesis, but earlier

- Risks
 - o Miscarriage - 1 in 100
 - o Cramping and vaginal bleeding
 - o Rh sensitization
 - o Infection



Fertility Assistance

- Surrogate Mothers
- In Vitro fertilization (IVF) – In vitro means “in glass”
 - o ICSI – Intracytoplasmic sperm injection
 - o ZIFT – Zygote intrafallopian transfer
 - o GIFT – gamete intrafallopian transfer
- TSE - Testicular sperm extraction
- Hormone Treatment (fertility drugs)
- Cryopreservation of sperm, eggs



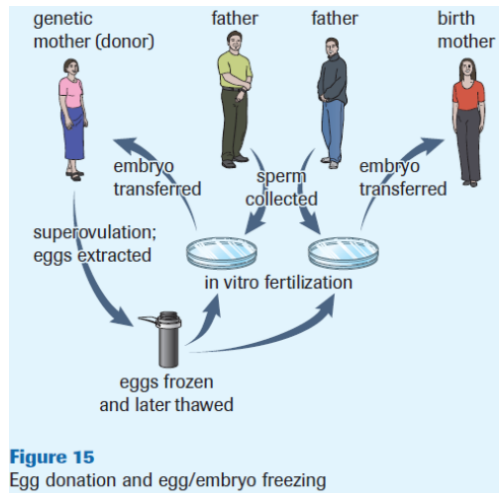
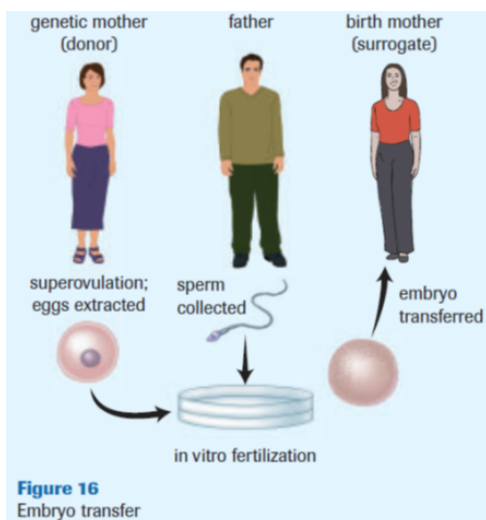
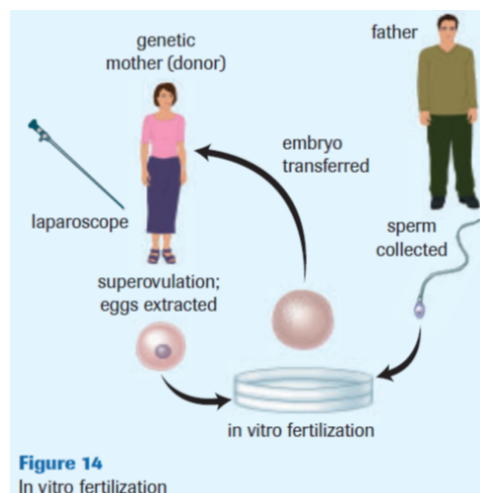
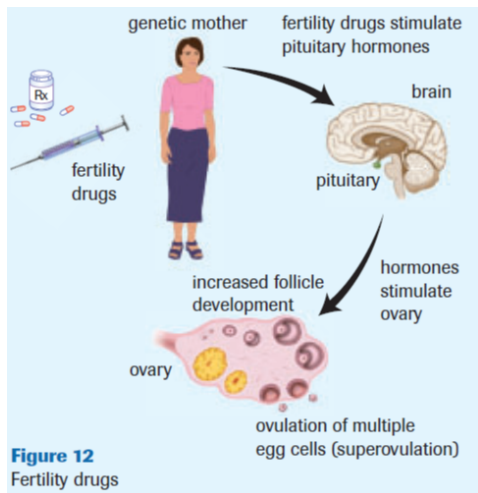
<https://www.youtube.com/watch?v=uXsCngh89fl>



<https://www.youtube.com/watch?v=P27waC05Hdk>



<http://www.sumanasinc.com/webcontent/animations/content/invitrofertilization.html>
<http://www.abc.net.au/science/lcs/ivf.htm>



Effect of environmental contaminants

Teratogens – any medication, chemical, infectious disease, or environmental agent that might interfere with normal development of a fetus or embryo

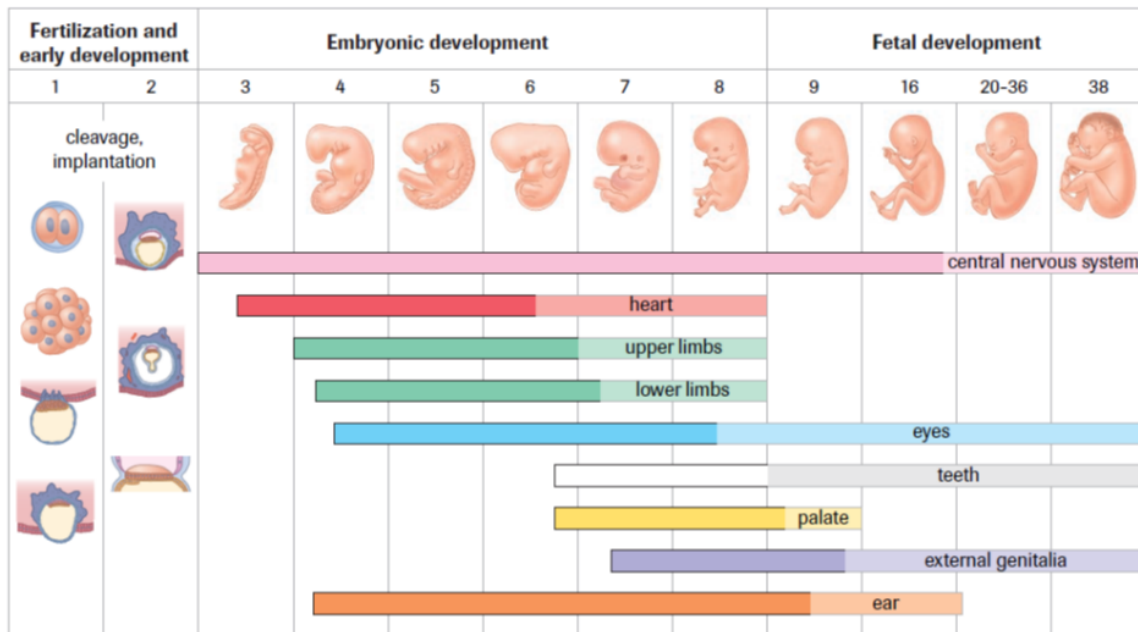


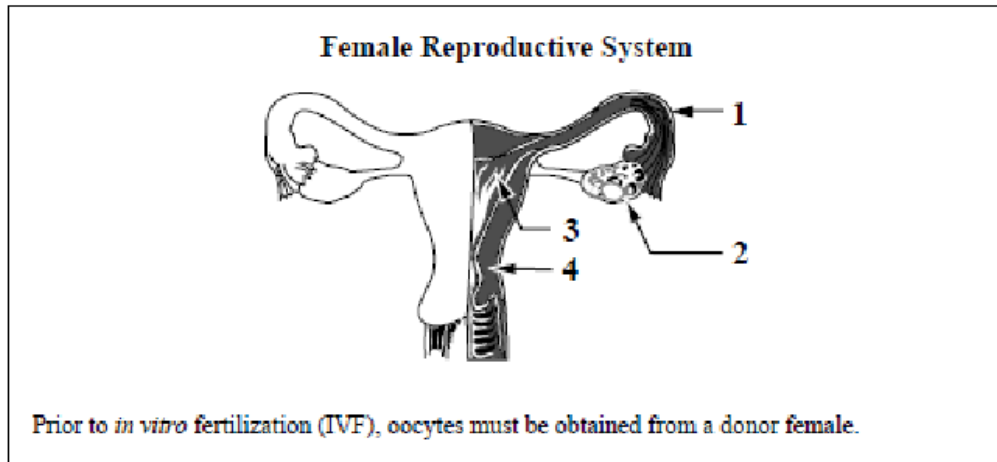
Figure 7 Periods of system and organ development during embryonic and fetal development. Dark areas indicate stages of development that are most sensitive to the effects of teratogens.

Table 3 Effect of Teratogens on the Developing Embryo

Groups	Agents	Effects on embryo
social drugs	alcohol	Alcohol crosses the placenta to the baby. It can accumulate in the amniotic fluid surrounding the baby before the birth and cause problems such as miscarriage, stillbirth, bleeding during pregnancy, and premature births.
	cigarettes	Carbon monoxide and nicotine reduce the amount of oxygen available in the mother's blood, which can affect the development and size of the baby.
	cocaine	Cocaine increases the heart rate in both the mother and baby, and the supply of oxygen and blood to the baby is reduced, which makes it more likely that the baby will be small and grow slowly. Several cases of bleeding in the brain have been reported in babies whose mothers were dependent on cocaine.
medications	thalidomide	Thalidomide blocks blood vessels that lead to the limbs.
	seizure medication (Dilantin, Tegretol, and valproic acid)	Seizure medication reduces blood flow to the central nervous system.
infectious diseases	rubella	The rubella virus enters the respiratory tract via airborne droplets and spreads to the lymphatic system.
	genital herpes	A pregnant woman who develops genital herpes can pass the virus to her fetus. This produces a higher risk of premature delivery. Newborns rarely become infected with herpes; however, half of those who do become infected either die or suffer neurological damage.

Outcome 2
 Class 3 - Technology in monitoring fetal development/Effect of environmental
 contaminants on fetal development
 Review Assignment

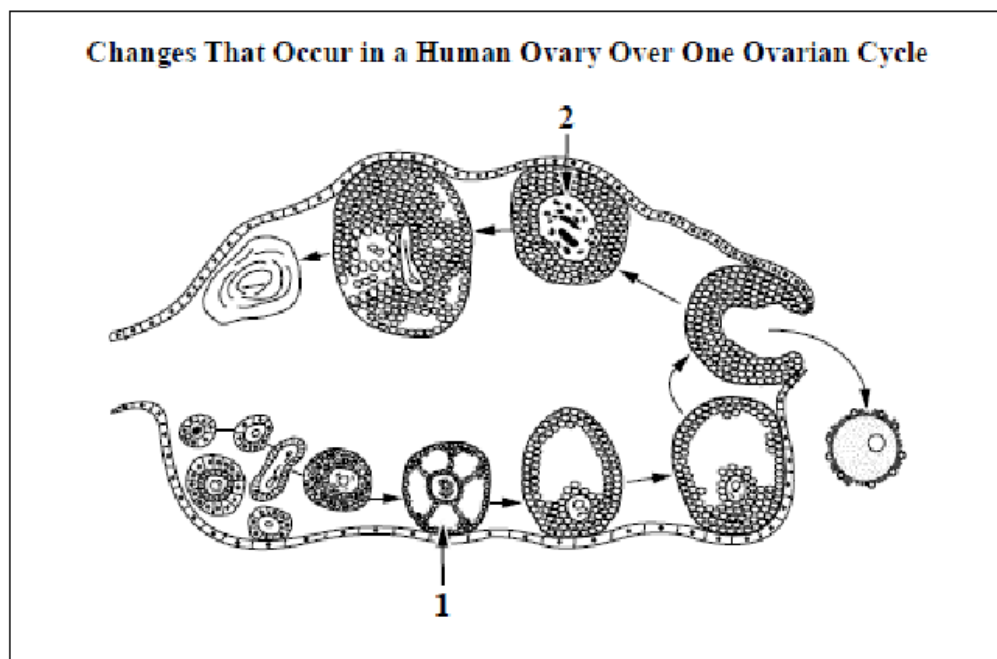
Use the following additional information to answer the next question.



To obtain oocytes for *in vitro* fertilization, the structure numbered above that must be hormonally stimulated is

- A. 1
- B. 2
- C. 3
- D. 4

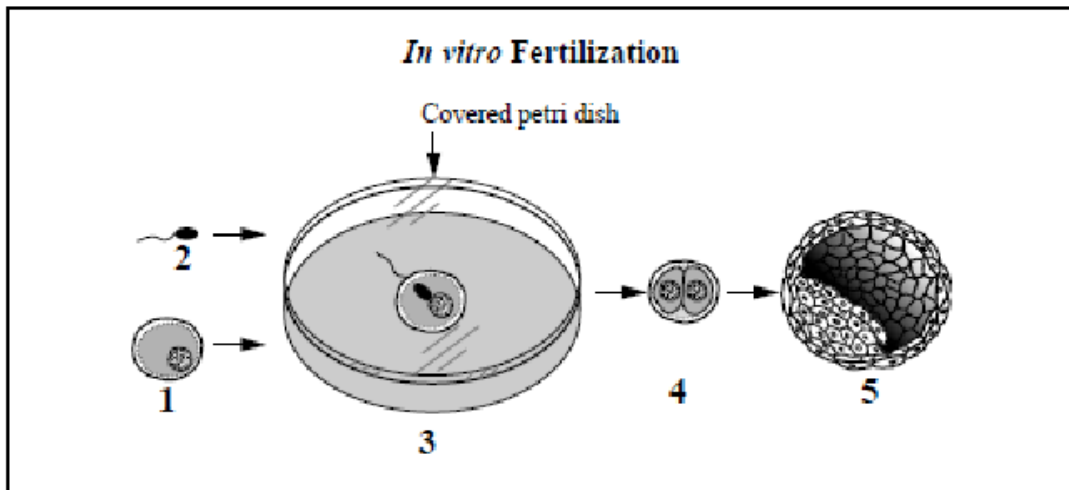
Use the following additional information to answer the next question.



In order for artificial implantation to be successful, what hormone would a female need to take to maintain the uterine lining for implantation, and which of the structures of the ovary numbered above would naturally produce this hormone?

- A. Estrogen and structure 1
- B. Estrogen and structure 2
- C. Progesterone and structure 1
- D. Progesterone and structure 2

Use the following additional information to answer the next question.



Numerical Response

2. Match the parts of the diagram numbered above that represent the terms given below.

Part of Diagram: _____
 Terms: Oocyte Blastocyst First mitotic division Fertilization

Use the following information to answer the next three questions.

In vitro fertilization techniques can enable postmenopausal women (those who have gone through menopause) to have babies. Eggs are removed from a female donor and are fertilized in a culture dish. The early embryo is inserted into the uterus of the postmenopausal woman. The postmenopausal woman requires hormone supplements for implantation and development to succeed.

- To increase the chance of successful implantation of an embryo produced by *in vitro* fertilization, the postmenopausal woman must receive
- A. FSH and LH to promote the development of the follicle
 - B. FSH and LH to promote the development of the endometrium
 - C. estrogen and progesterone to promote the development of the follicle
 - D. estrogen and progesterone to promote the development of the endometrium

- After *in vitro* fertilization, hormone supplements are administered until the fourth month of pregnancy. At this time, the hormone supplements may be discontinued because the
- A. placenta produces oxytocin to inhibit uterine contraction
 - B. pituitary produces oxytocin to inhibit uterine contraction
 - C. placenta produces progesterone and estrogen to maintain the uterine lining
 - D. pituitary produces progesterone and estrogen to maintain the uterine lining

- During the first trimester of a pregnancy, an extraembryonic membrane secretes HCG. In a pregnancy resulting from *in vitro* fertilization of a postmenopausal woman, HCG would **not** function normally because the
- A. woman's pituitary would not respond
 - B. placenta would not produce FSH or LH
 - C. woman would not have a corpus luteum
 - D. placenta would not be permeable to hormones

- The villus region sampled using CVS develops from the
- A. amnion
 - B. chorion
 - C. ectoderm
 - D. endoderm

Outcome 2

Class 4 – Birth and Lactation

Pre-Class Reading Assignment

1. Read pgs 536-539
2. Define the following terms
 - a. Parturition
 - b. Relaxin
 - c. Oxytocin
 - d. Prolactin
 - e. Colostrums

Outcome 2**Class 4 – Birth and Lactation****Notes**

<https://www.youtube.com/watch?v=dYu-0rOnLpA>

Birth (aka parturition)

- Begins approx 266 days after implantation
- Prior to birth, **progesterone** levels fall
 - This starts uterine contractions
 - Amniotic sac is under pressure and bursts
 - Water breaks
 - This lubricates the birth canal
- **Relaxin** – hormone produced by the placenta prior to labor
 - Causes ligaments in the pelvis to loosen
- **Oxytocin** – released from posterior pituitary
 - Causes strong uterine contractions

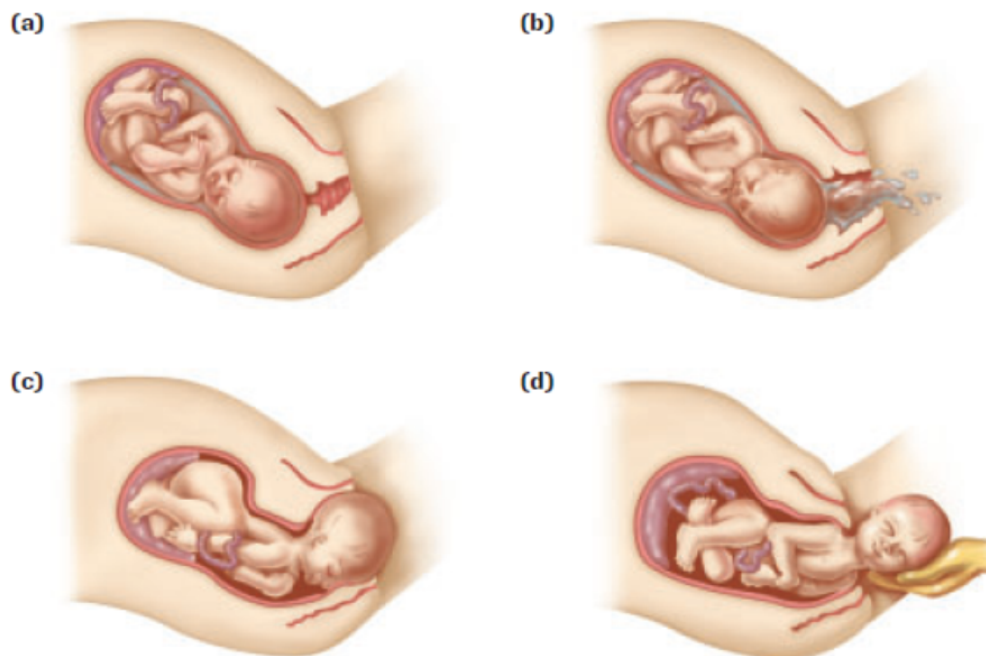


Figure 9 

Parturition (labour) begins when **(a)** the cervical opening starts to enlarge. Next **(b)**, the amniotic sac breaks and fluid flows out. Contractions of the uterine muscles push the baby from the uterus **(c)** until it emerges from the birth canal **(d)**.

Lactation

- Breasts develop at puberty, stimulated by **estrogen** and **progesterone**
- Higher levels during pregnancy prepare the breasts for milk production
- **Prolactin** is released from the pituitary gland in low amounts during pregnancy
 - Stimulates glands in the breasts to begin to produce fluids
 - Levels increase dramatically after birth
- Suckling action of newborn stimulates nerve endings in the areola of the breast
- Sends signal to pituitary which releases **oxytocin** into the blood
- Blood carries oxytocin to:
 - The **breast** where it causes contractions of smooth muscle which forces milk to the nipple
 - The **uterus** where it causes the uterus to return to its original shape/size

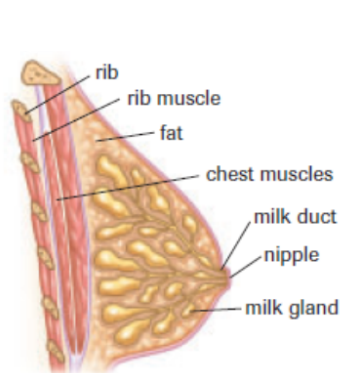


Figure 10
Structure of the human breast

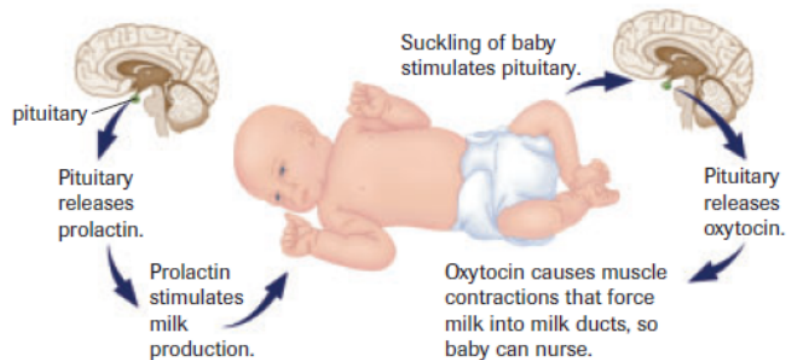


Figure 11
The hormone prolactin stimulates the breast to produce milk. The suckling action of the baby initiates a hormonal reflex involving the hormone oxytocin.

<https://www.youtube.com/watch?v=DQj-Mn0c370>



<https://www.youtube.com/watch?v=xmNzUEmFZMg>



Benefits of Breastfeeding

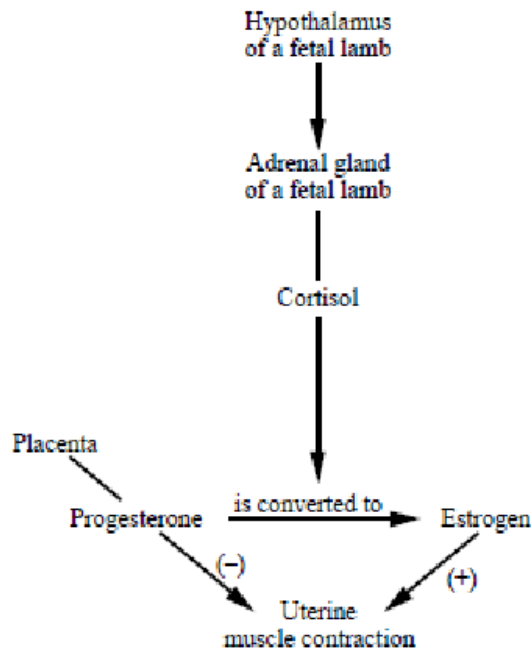
- Breast milk also contains antibodies and other immune factors that help prevent and fight off illness
- Releases prolactin and oxytocin which help relax mother and quicken the return of the uterus back to normal
- may be easier for a nursing mother to lose the pounds of pregnancy
- creating an early attachment between mother and child

Outcome 2
Class 4 - Birth and Lactation
Review Assignment

Use the following information to answer the next four questions.

Research on sheep might explain what stimulates pregnant mammals, including humans, to give birth. Through research on pregnant sheep, scientists have developed the following scheme to explain normal events as birth begins.

Influence of Fetal Hormones on the Maternal Reproductive System



Note: The placenta produces progesterone throughout the pregnancy, but activation of the fetal hypothalamus only occurs as birth begins.

—from *Discover*, 1992

- According to this diagram, the birth of a lamb is linked to
- A. increasing levels of estrogen in pregnant sheep
 - B. decreasing production of cortisol by the fetal lamb
 - C. increasing levels of progesterone in pregnant sheep
 - D. decreasing activity of the hypothalamus by the fetal lamb

- To maintain a pregnancy for a normal gestation period, the contraction of uterine muscles is inhibited. According to the diagram, this inhibition is brought about by
- A. high levels of estrogen from the placenta
 - B. low levels of progesterone from the uterus
 - C. high levels of cortisol from the adrenal gland
 - D. high levels of progesterone from the placenta

- Which of the following statements concerning human reproduction is supported by the findings of this research?
- A. Developments within the fetus determine when birth will begin.
 - B. The production of fetal cortisol delays birth until gestation is complete.
 - C. During early fetal development, fetal hormones do not pass into the mother.
 - D. High levels of progesterone in the mother's blood are essential for birth to begin.

Use the following additional information to answer the next question.

Ingestion of a plant called skunk cabbage by pregnant sheep has been found to cause severe birth defects and to delay birth for several weeks.

- A reasonable hypothesis is that skunk cabbage contains a chemical that
- A. increases uterine sensitivity to estrogen
 - B. decreases placental production of progesterone
 - C. inhibits the fetal hypothalamus or adrenal gland
 - D. increases conversion of progesterone to estrogen

Use the following information to answer the next question.

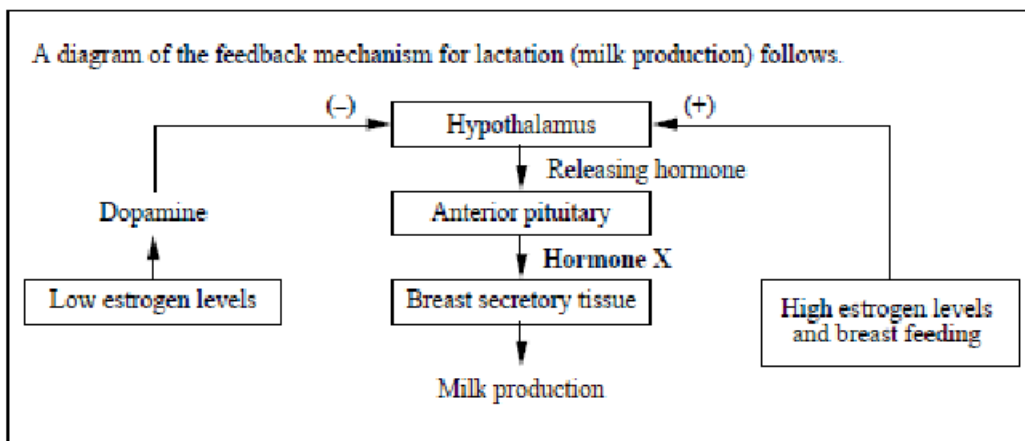
Some Events in Labour

- 1 Uterine contractions increase in force.
- 2 Oxytocin travels through the bloodstream.
- 3 Nervous impulses are sent to the hypothalamus.
- 4 Oxytocin is released from the posterior pituitary.

Numerical Response

3. At the onset of labour, a baby's head pushes on the cervix. Following this, the events given above, listed in the order in which they occur, are _____, _____, _____, and _____.

Use the following information to answer the next two questions.



- The reason males do not lactate even though they have breast tissue is that
- A. estrogen levels in males are too low to overcome the inhibiting action of dopamine
 - B. males do not need to produce milk, thus the breast tissue in males is not designed to produce milk
 - C. males have a Y chromosome, which has a gene that prevents the breast secretory tissue from producing milk
 - D. males have high levels of testosterone, which inhibits the pituitary from releasing the hormone that stimulates lactation

- Hormone X, which initiates and maintains milk production in females, is
- A. estrogen
 - B. oxytocin
 - C. prolactin
 - D. progesterone

- The onset of labour at the end of pregnancy is caused partly by a decreased level of
- A. LH
 - B. FSH
 - C. estrogen
 - D. progesterone

Use the following information to answer the next question.

In rare cases, human males develop functioning mammary glands. Hormone levels are known to affect the development and function of mammary glands in both males and females.

- For human males to produce milk and to eject milk, high levels of which two, respectively, must be present?
- A. Prolactin and relaxin
 - B. Relaxin and prolactin
 - C. Prolactin and oxytocin
 - D. Oxytocin and prolactin