

FERTILIZATION AND DEVELOPMENT

In the male, sperm travel from the epididymis through the vas deferens and out through the urethra during ejaculation into the vagina.

Hundreds of millions of sperm are deposited - many will die in the vagina's acidic environment, others will die before they get through the uterus and enter the oviducts.

If there is an egg in the oviduct - fertilization will take place here.

FERTILIZATION - several sperm may reach the egg, but only one can fertilize the egg. The first one to get there releases enzymes that break through the egg and stimulate the egg at the same time to make a barrier to any other sperm.

Once the sperm nucleus fuses with the egg a **zygote** is formed.

(Twins - **identical** twins come from one zygote that separates during division to become two identical beings. **Fraternal** twins result from two different eggs that are fertilized by two different sperm)

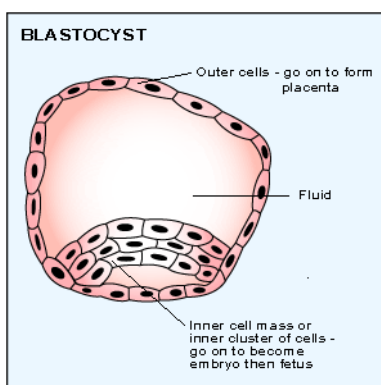
The zygote will then travel down the oviduct to the uterus, where implantation will occur at about the end of the first week.

During this time, the zygote divides.

Cleavage - this is when the zygote first starts to divide, but it does not change in overall size - the cells become smaller with each division. **From the time it begins cleavage until bone cells begin to form weeks later - it is known as an embryo.**

While the embryo is undergoing cleavage the mass of identical cells within it is called a **morula**.

By the time the embryo reaches the uterus it has divided enough to form a nearly hollow ball of cells called a **blastocyst**. Inside the blastocyst is a group of cells called the **inner cell mass**. These will become the baby. The outer layer of the blastocyst is called the **trophoblast**. This will produce the membranes that will surround the developing embryo.

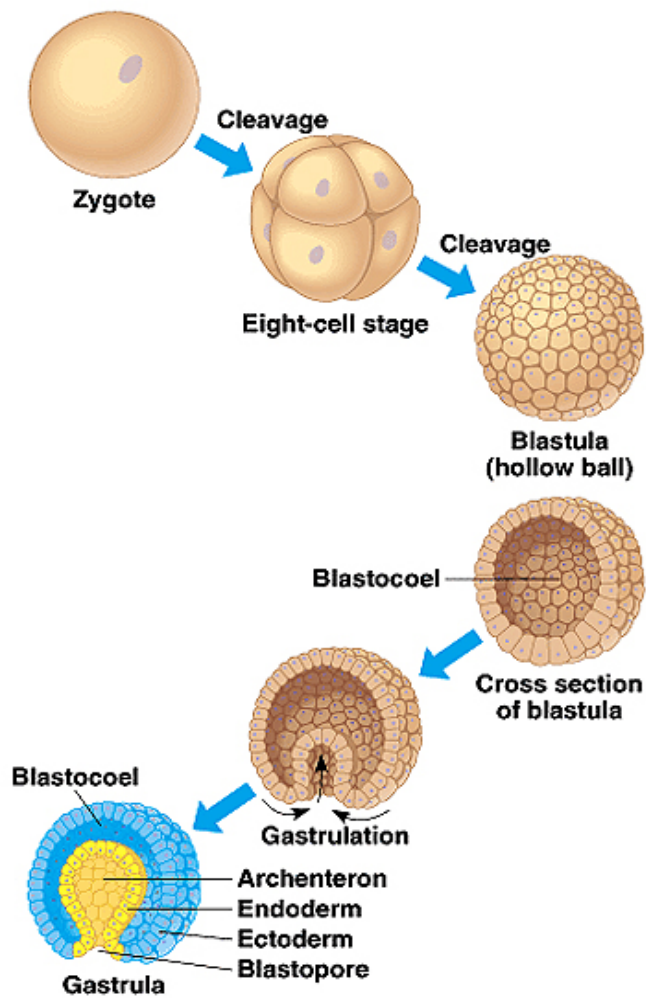


The trophoblast secretes a hormone called HCG (Human Chorionic Gonadotropin) This hormone prevents the corpus luteum from disintegrating. This way the corpus luteum keeps making progesterone, the endometrium is maintained and menstruation is prevented. This happens until the placenta is made (for about three weeks)

*** Traces of HCG are released in urine as soon as the trophoblast begins to produce it. This is the hormone that is detected by pregnancy tests ***

DEVELOPMENT

Up until now, all the cells of the blastocyst are the same. During the second week they begin to specialize.



Copyright © Pearson Education, Inc., publishing as Benjamin Cummings.

This process is called **GASTRULATION** and the embryo is called a **gastrula**.

The cells grow, divide and migrate into three layers called germ layers:

1. **ectoderm** - forms the skin and nervous system
2. **mesoderm** - forms the kidneys, skeleton, muscles, blood vessels and gonads
3. **endoderm** - forms the lining of the digestive tract and the lungs

EMBRYONIC (PRIMARY) MEMBRANES

- not part of embryo, but nourish, support and protect it
- are fairly similar among all vertebrates

1. Chorion

- in chick found next to shell, for gas exchange
- in humans develops into placenta

2. Amnion

- contains amniotic fluid to cushion and protect the embryo

3. Allantois

- in chicks, collects waste
- in humans, develops into the blood vessels of the umbilical cord

4. Yolk and Yolk Sac -

- yolk is dense material that nourishes the embryo in most vertebrates, like the chick
- in humans there is very little yolk, but there is a yolk sac that becomes the first site of blood cell formation

NEURAL DEVELOPMENT

In the gastrula, mesoderm cells along the back become a rod called a **notochord**.

The ectoderm just above the notochord thicken, folds, and fuses to become a tube (**neural tube**)

The anterior (head) part of the tube becomes the brain.

Occurs at about the third week - embryo is called a **neurula**

It is amazing to realize that a clump of identical cells becomes a baby in about 38 weeks. During this time the cells **differentiate** - become specialized.

Once bone cells begin to form, the embryo is now a **fetus**.

How does the fetus get nourishment, oxygen, waste disposal?

The placenta and umbilical cord:

- the placenta forms from the chorion once the embryo is implanted
- the chorion forms tree-like projections which anchor into the uterus
- these projections contain many blood vessels
- the chorion plus these projections make up the placenta
- the placenta produces progesterone and estrogen to keep the body from shedding the endometrium and also stops FSH and LH

The umbilical cord is the connection between the developing fetus and the placenta

- mother's blood and fetus's blood don't directly mix
- O₂ and nutrients diffuse from mother's blood into placenta and then into fetus through the umbilical cord
- CO₂ and wastes from the fetus travel through the umbilical cord into the placenta then into the mother's bloodstream

TERATOGENS

- any agent that causes a structural abnormality to the developing fetus

Includes:

- alcohol
- cigarette smoke
- prescription or over-the-counter drugs
- X-rays
- certain pollutants like PCBs, mercury compounds, lead compounds

Some birth defects are due to genetics, however. Any major defect may be detected and even repaired in some cases before birth!

Detecting problems:

1. **Ultrasound** - sound waves bounce off and create an image of the fetus. Good for detecting limb, heart or mouth malformations. Ultrasound can be done at any time during pregnancy
2. **Amniocentesis** - a thin needle extracts a sample of the amniotic fluid from the abdomen to obtain cells from the fetus. These cells are cultured and studied by karyotyping to look for genetic, usually chromosomal abnormalities. This can't be done before the fourteenth week of pregnancy
3. **Chorionic villi sampling (CVS)**
Cells can be karyotyped after removal from the chorion. Can be done as early as nine weeks. Used to detect the same sorts of abnormalities as amniocentesis

4. **Fetoscopy** - a long tube with a camera on the end can be used to observe the fetus directly. Some medical procedures can actually be done using fetoscopy - like removing excess fluid from the brain or doing blood transfusions. Blood samples can be collected to detect for blood diseases or disorders

BIRTH

After about 280 days gestation, birth is triggered by hormonal events:

- progesterone and estrogen drop
- prostaglandins may be released
- prostaglandins may trigger oxytocin which causes uterus to contract
- “water breaks” puts pressure on the cervix and increases uterine contractions which increases oxytocin (positive feedback example)

Stages of Childbirth:

1. Dilation Stage (2-20 hours)
Oxytocin and uterine contractions cause cervix to open (dilate)
2. Expulsion Stage (0.5-2 hours)
Forceful contractions push the baby through the cervix and into the birth canal (vagina)
3. Placental Stage (10-15 minutes)
The placenta and umbilical cord are expelled from the uterus (called the afterbirth)

If there is anticipation of a problem, such as the mother having a very small pelvis, an STI, or possible complications, the physician may perform a Caesarean Section where an incision is made into the abdomen and uterus. The baby is then delivered through the incision.

Lactation:

High levels of estrogen and progesterone keep the pituitary gland from releasing prolactin. After birth, these hormone levels drop suddenly and within a few days, prolactin is released which causes milk production.

Oxytocin is also involved in breastfeeding. A suckling infant stimulates nerve endings in the nipple which stimulates the release of oxytocin in a positive feedback loop. The more the infant feeds, the more milk will be “let down” into the ducts.