FERTILIZATION

- Fertilization is the first stage of development which occurs when a sperm joins with an egg to form a **zygote** (fertilized egg).
- Only one sperm enters an egg. After the sperm enters the egg, the egg is stimulated to develop an impenetrable coating around it to prevent other sperm from entering.
- Fertilization occurs in the oviduct (fallopian tube) and once it is formed the zygote travels down the length of the oviduct and into the uterus or womb.

FERTILIZATION (CON’T)

- After it is formed, the zygote goes through a series of cell divisions which we call **cleavage**.
- All of the cells which are produced from the cleavage process are identical and we call this group of identical cells a **morula**.
- From the time a zygote is formed, until it begins to differentiate, we call an organism an **embryo**.

FERTILIZATION (CON’T)

- By the time the embryo reaches the uterus it has formed into a hollow ball of cells called a **blastocyst**.
- The inner portion of the blastocyst contains a group of cells called the **inner cell mass**, this group of cells will develop into a **fetus** (baby).
- The outer portion of the blastocyst contains a layer of cells called the **trophoblast**. The trophoblast develops into membranes such as the amniotic sac which will nourish and protect the developing embryo.
**IMPLANTATION**

- At the end of the first week of pregnancy, the embryo attaches itself to the endometrium of the uterus, a process called implantation.
- After implantation, the cells of the trophoblast secrete a hormone called human chorionic gonadotropin (HCG). This hormone keeps the corpus luteum from dissolving.
- The corpus luteum continues to produce the hormone progesterone which keeps the endometrium thick and rich in blood, preventing menstruation.

**TWINS**

- Normally, one egg is released from the ovaries during ovulation and is fertilized by a sperm to produce one offspring.
- However, one in every 86 births results in twins.
- There are two types of twins:
  1. Fraternal twins
  2. Identical twins

**IDENTICAL VS. FRATERNAL TWINS**

**Identical Twins**
- Identical twins form from one fertilized egg.
- In this situation, the single zygote splits into two halves during the early stages of its development.
- Since they were both formed from a single cell, the offspring are genetically identical.
- About 30% of all twins are identical twins.

**Fraternal Twins**
- Fraternal twins form when two eggs are released from the ovaries and each egg is fertilized by a sperm.
- Although they are called twins, the offspring are genetically different from each other.
- About 70% of all twins are fraternal twins.

**EMBRYONIC DEVELOPMENT**

- During the first week of its development, an embryo’s cells are identical to each other. However, during the second week the cells begin to differentiate or specialize.
- This process of cell differentiation is called gastrulation. At this stage, the embryo is called a gastrula.
- During gastrulation, the embryo’s cells develop into three distinct layers which include:
  1. Ectoderm
  2. Mesoderm
  3. Endoderm
EMBRYONIC DEVELOPMENT

- The cells in each of these layers are different from each other and each layer will eventually develop into different parts of the body.
- See Fig. 15.14, Pg. 508

PRIMARY MEMBRANES

- Humans, like most other animals, go through the embryonic stages of zygote, morula, blastocyst, and gastrula.
- The primary membranes are not part of the actual embryo. They are used to support, nourish and protect the embryo.
- The primary membranes in a human are very similar to those in a chicken embryo
- See Fig. 15.15, P. 509.

PRIMARY MEMBRANES (CON’T)

The four primary membranes include:
1. **Chorion** – Develops into the placenta
2. **Amnion** – contains amniotic fluid that helps to cushion the developing embryo
3. **Allantois** – Used to collect waste
4. **Yolk or Yolk sac** – the site of first blood cell formation. In many species it provides a nutrient source for the embryo (i.e. chicks)

NEURAL DEVELOPMENT

- The nervous system develops from the mesoderm section of the gastrula.
- The mesoderm cells join together to form a structure called the notochord.
- In the third week of development, a neural tube forms and the embryo is now called a neurula.
- The anterior part of the neural tube eventually forms into a brain.
DIFFERENTIATION

Eventually, the three cell layers of the gastrula develop into different parts of the body, this is called differentiation.

Over a period of 38 weeks, a tiny clump of identical cells develop into a human being with fully formed tissues and organs.

The 38 weeks are divided into three time periods called trimesters. These are called the first, second, and third trimesters. Each trimester lasts about 3 months.

FIRST TRIMESTER: WEEKS 1 - 12

- During this first stage a number of things develop in the embryo.
- At the end of 3 weeks, the embryo is called a neurula. At this stage the embryo has the beginnings of a nervous system.
- At the end of 4 weeks, the limbs, eyes and spine begin to form.
- At 8 to 9 weeks, the first bone cells begin to form. It is known as a fetus at this stage.

SECOND TRIMESTER: WEEKS 13 - 24

- At 12 weeks, all of the major organs have started to form including; the liver, stomach, brain, and heart. As well, a noticeable head and limbs have developed.
- The fetus is only 100 mm long at the end of this stage.
- In this stage, the fetus develops an audible heartbeat.
- The skeleton begins to form.
- The brain and the nervous system develop further.
- The limbs continue to develop.
- At the end of 24 weeks, most of a fetus organs have developed.
- The fetus is 300 mm long after 24 weeks.
THIRD TRIMESTER: WEEKS 25 - 38

- In the third trimester, the fetus size increases quickly.
- The immune system develops.
- The brain continues to grow and develop.
- The fetus opens its eyes at the end of the eighth month.
- At the end of 9 months, the fetus is around 525 mm long and weighs about 3.38 kg.

THE PLACENTA & UMBILICAL CORD

- The placenta and umbilical cord provide the developing fetus with nourishment, oxygen and waste removal.

- The placenta is a thick membrane filled with blood vessels. It is formed from the chorion membrane. The placenta produces progesterone and estrogen. These hormones prevent any new follicles from maturing and keeps the endometrium thick and filled with blood. The placenta helps to provide nutrients and oxygen to the fetus and removes wastes.

- The umbilical cord is a tube which connects the fetus to the placenta.

- Since the mother’s and fetus blood never mix, the placenta is very important in the diffusion of materials between the bloods of the mother and fetus.
EFFECTS OF TERATOGENS ON DEVELOPMENT

- A pregnant mother transfers beneficial and harmful substances to the fetus.
- Many harmful substances can affect the normal development of the fetus. Substances which can cause a structural abnormality to a fetus during pregnancy are called teratogens.
- Examples of teratogens include:
  - Cigarette smoke
  - Alcohol
  - Prescription & Over the counter drugs
  - Radiation (X-rays, etc.)
  - Pollutants

BIRTH

- The birth process is triggered by a number of hormones such as:
  - Progesterone
  - Estrogen
  - Prostaglandins
  - Oxytocin
- The prostaglandins and oxytocin cause the uterus to contract. Contractions are the beginning of labour.
  - Breeched birth – baby delivered buttocks first
  - Caesarean section – baby delivered via an abdominal incision
- There are 3 stages of birth:
  - Dilation stage
  - Expulsion stage
  - Placental stage
- See page 513

LACTATION

- Lactation is the formation and secretion of breast milk from the pregnant mother.
- This process is controlled by hormones.
- Prolactin is the hormone which controls the production of milk in a pregnant female.
- Initially, the breasts secrete a thin, yellowish fluid called colostrum, but eventually they secrete milk for the baby.

THE SUCKLING REFLEX

- A suckling baby will stimulate the release of milk from the female's mammary glands.
- The suckling reflex is demonstrated in Fig. 15.22, p. 514.
- It occurs in five stages:
  - Suckling stimulates nerve endings in the nipple and areola of the breast.
  - Nerves carry the stimulus to the hypothalamus.
  - The hypothalamus produces oxytocin which is released by the posterior pituitary gland.
  - Oxytocin causes the mammary lobules to contract.
  - Milk letdown (release of milk) occurs.