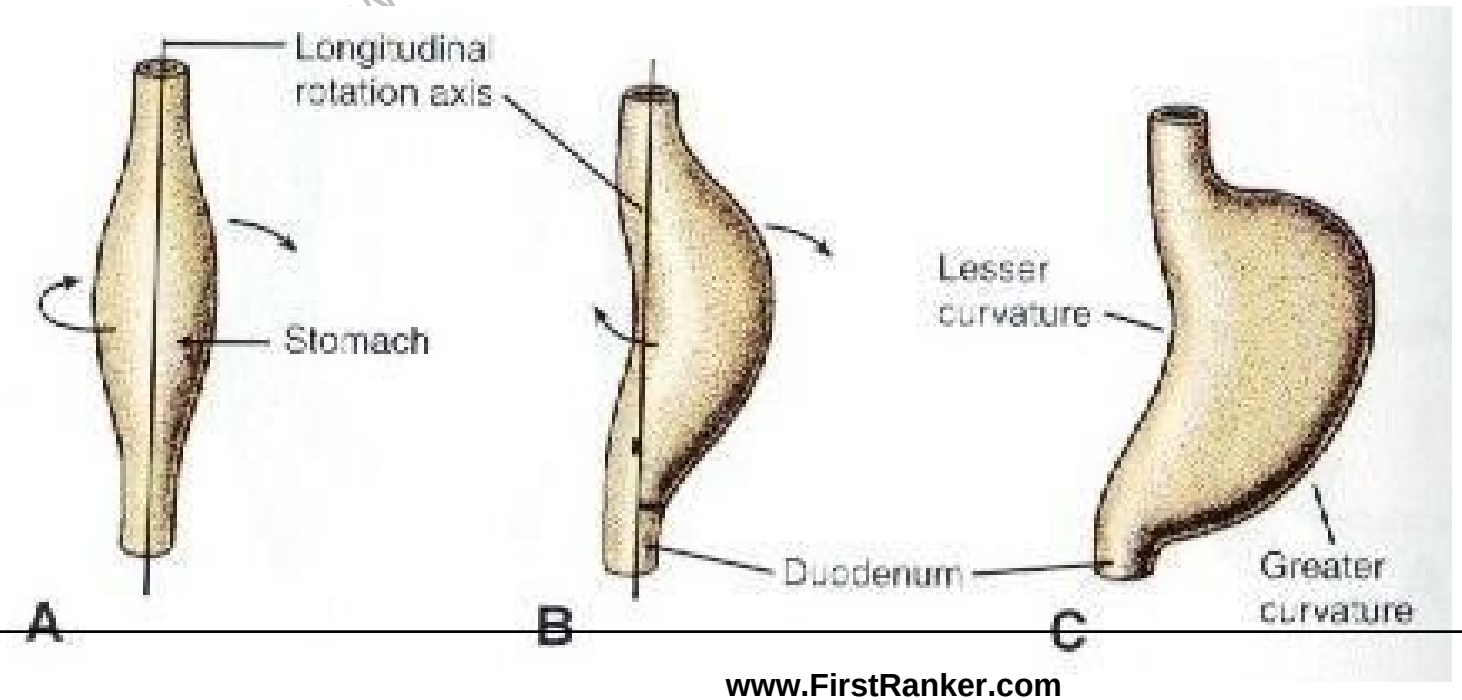
EMBRYOLOGY: OLD & NEW FRONTIERS

- **Embryology** means study of embryos, however the term generally refers to prenatal development of embryos and fetuses.
- **Developmental anatomy** is the field of embryology concerned with the changes that cells, tissues, organs, and the body as a whole undergo from a germ cell of each parent to the resulting adult.

SIGNIFICANCE OF EMBRYOLOGY

- Embryology explains the basis for understanding gross anatomy for e.g. why left vagus supplies the anterior surface of stomach



- Embryology also explains the causes of variation in human structure and birth defects for e.g. infectious agents, X rays or drugs.

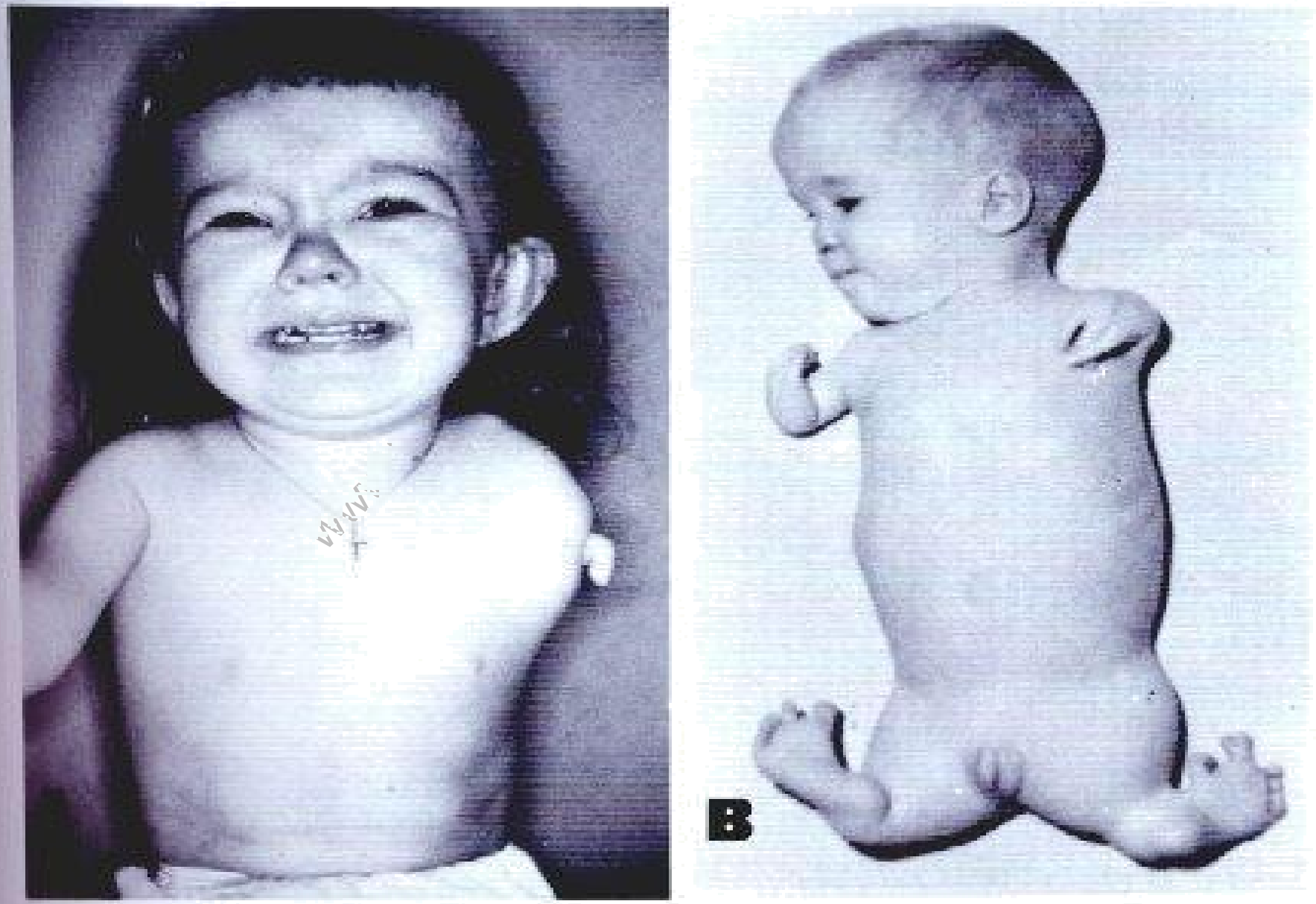
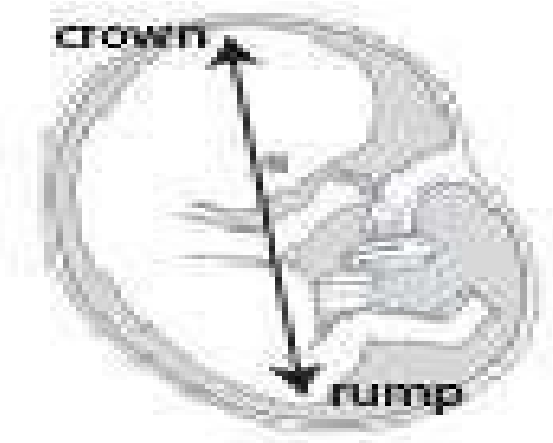
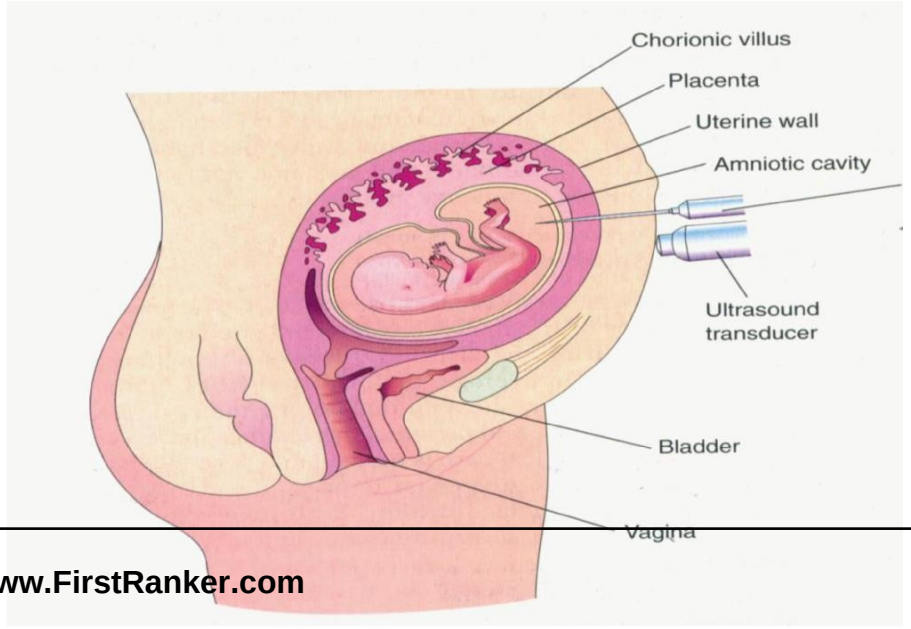


Figure 8.17. A. Child with unilateral amelia. B. Patient with a form of meromelia called phocomelia. The hands and feet are attached to the trunk by irregularly shaped bones.

- Embryology also provides knowledge essential for creating health care strategies for better reproductive outcomes.





BRIEF HISTORY

- Scientific approaches to study embryology have progressed over 100 of years. This is attributed to:
- Advances in optical equipment and dissection techniques
- Comparative and evolutionary studies
- Investigation of off springs with birth defects (abnormal development) ---- **Teratology**

20th CENTURY ADVANCEMENTS IN EMBRYOLOGY

- Observations of transparent embryos
- Use of vital dyes to stain living cells to follow their fates
- Radioactive labeled and autoradiographic techniques were employed
- Grafting experiments provided the first insights into molecular signaling between tissues
- Science of Teratology become prominent in1961 when a drug thalidomide caused limb defects and for the first time the association b/w the drug and birth defects was determined.
- Molecular approaches have been added such as reporter genes, fluorescent probes and markers

DEVELOPMENT

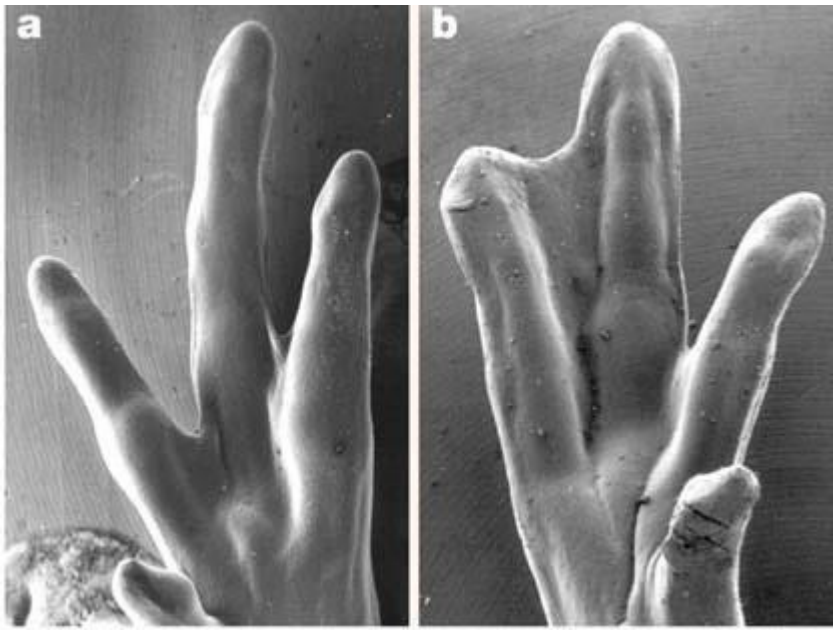
- Human development is a continuous process that begins at fertilization, when a fertilized oocyte (zygote), a totipotential cell is transformed into a multicellular human being.
- During this journey it has to pass through the stages of **cell division**, **cell migration, programmed cell death**, **differentiation**, **growth** and **cell rearrangement.**

CELLULAR DIFFERENTIATION

- Is the process by which a less specialized cell becomes a more specialized cell type.
- Differentiation occurs numerous times during the development of a multicellular organism as the organism changes from a simple zygote to a complex system of cell types and tissues.

APOPTOSIS

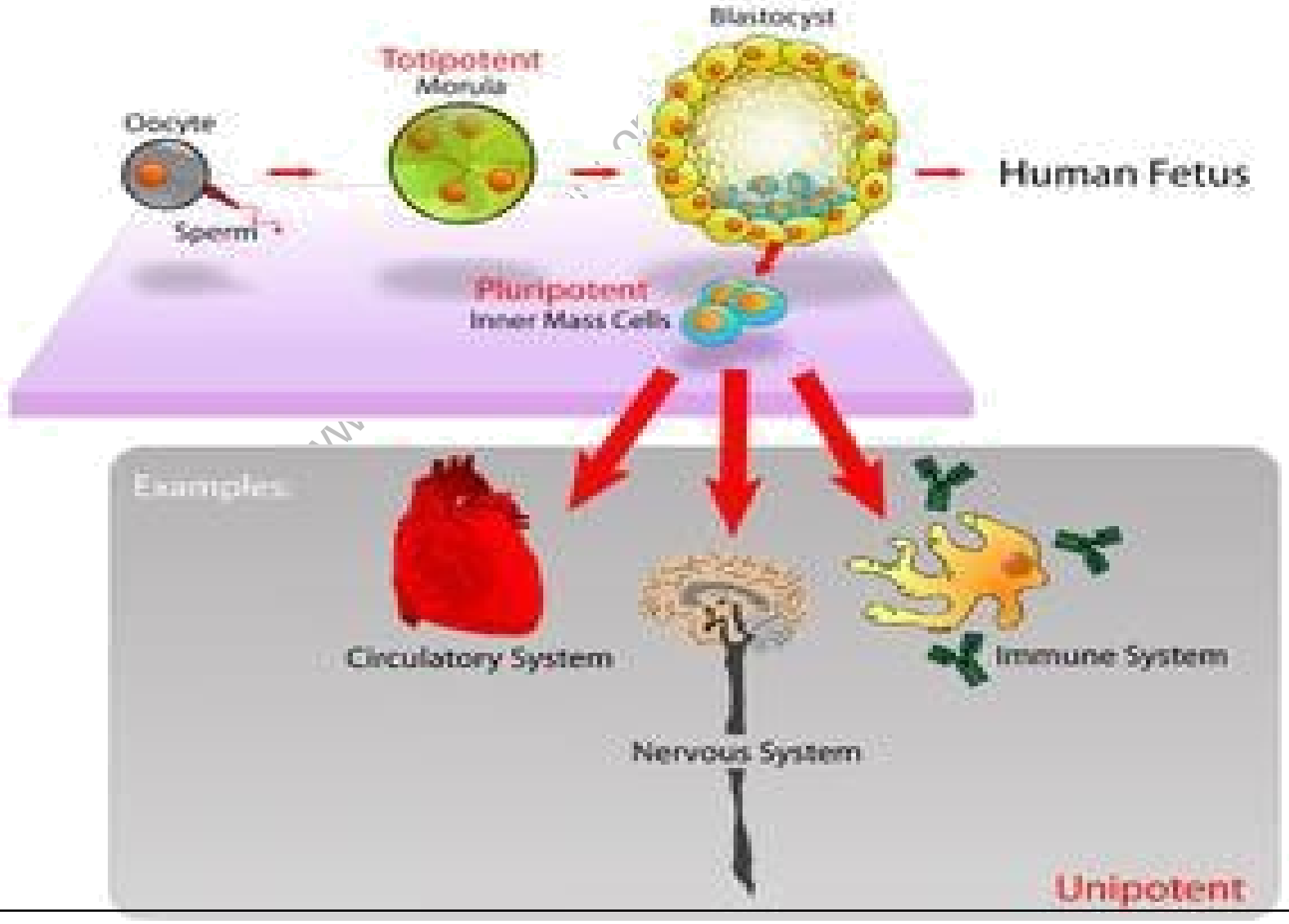
- Programmed cell death, is a normal component of the development of multicellular organisms.
- Cells die in response to a variety of stimuli and during apoptosis they do so in a controlled, regulated fashion.



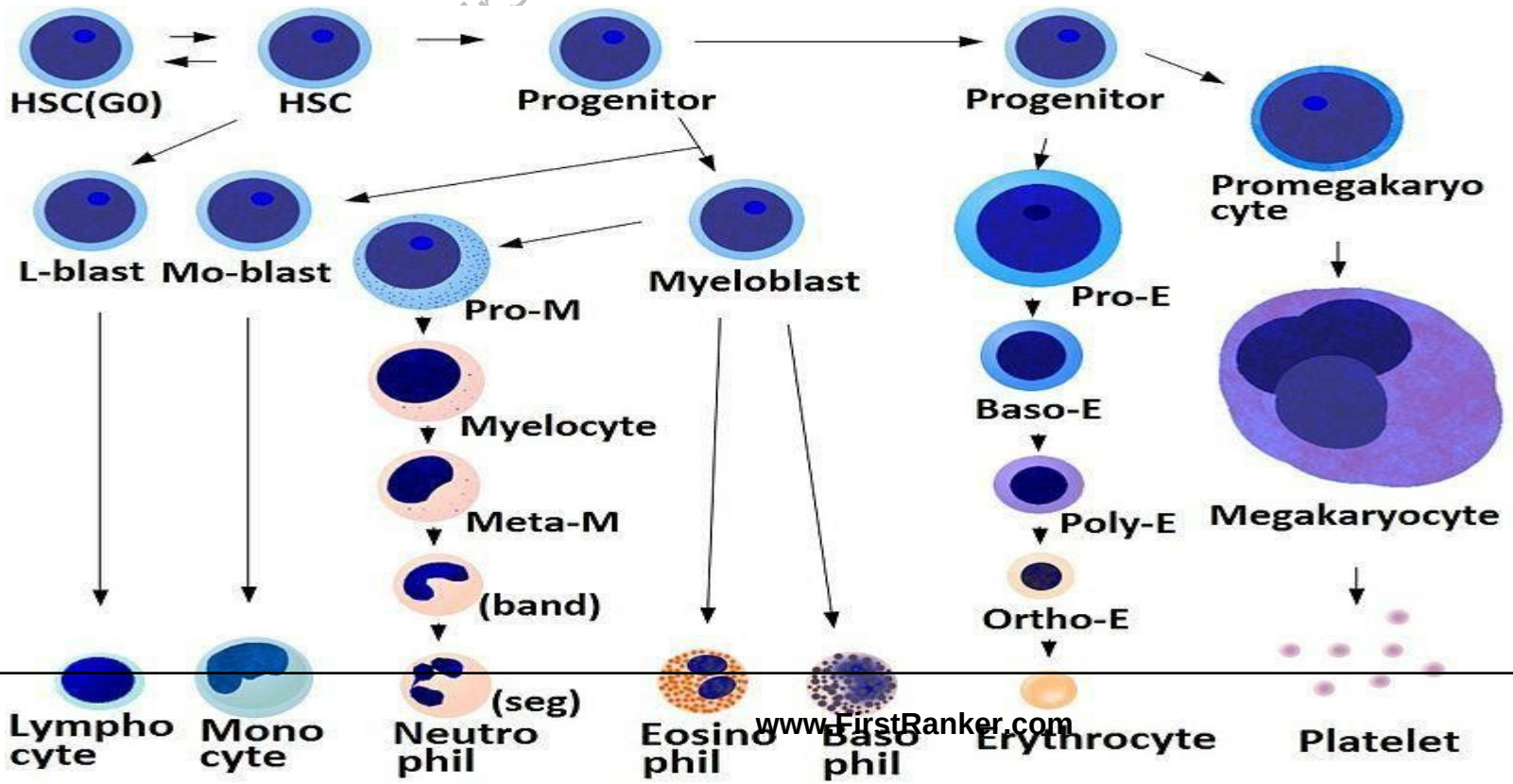
CELL POTENCY

Totipotent cell: A cell that is able to differentiate into **all cell types including the placental tissue.** In mammals, only the zygote and subsequent blastomeres are totipotent.

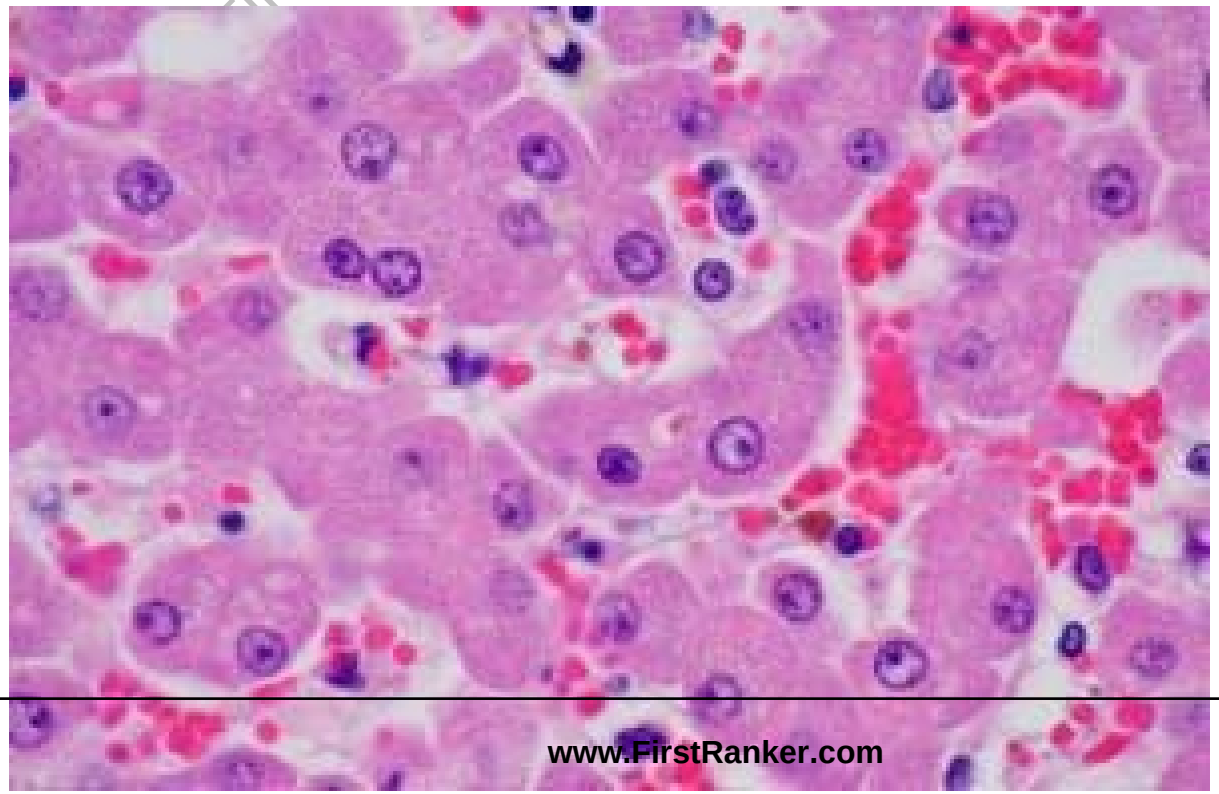
Pluripotent cell: refers to a stem cell that has the potential to differentiate into **any fetal or adult cell type.** i.e. into any of the three germ layers: endoderm, mesoderm, or ectoderm.



- **<u>Multipotent progenitor cells</u>:** have the potential to give rise to cells from multiple, but a limited number of lineages, for e.g.
- Hematopoietic stem cell — a blood stem cell that can develop into several types of blood cells, but cannot develop into brain cells or other types of cells.



- **<u>Unipotent cell or precursor cell:</u>** is one that has the capacity to differentiate into only one cell type, for e.g. Hepatocytes



HUMAN DEVELOPMENT

Is divided into:

1.Prenatal period

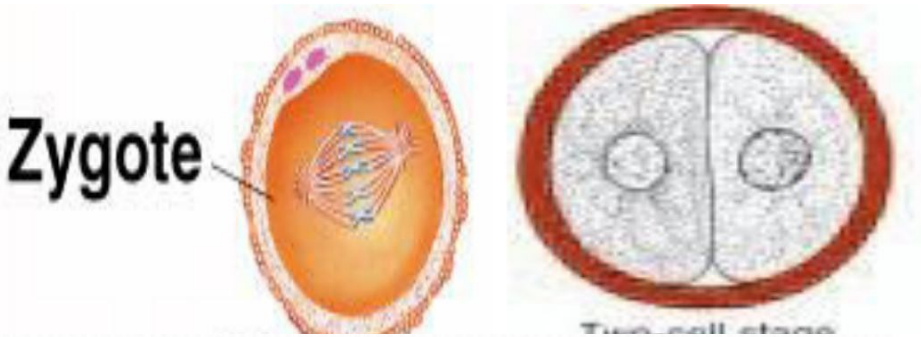
2.Postnatal period

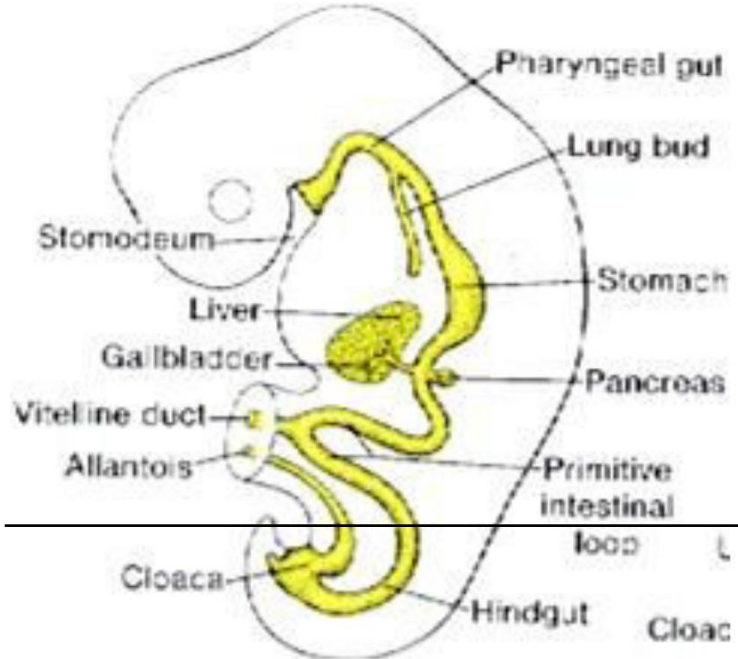
PRENATAL PERIOD

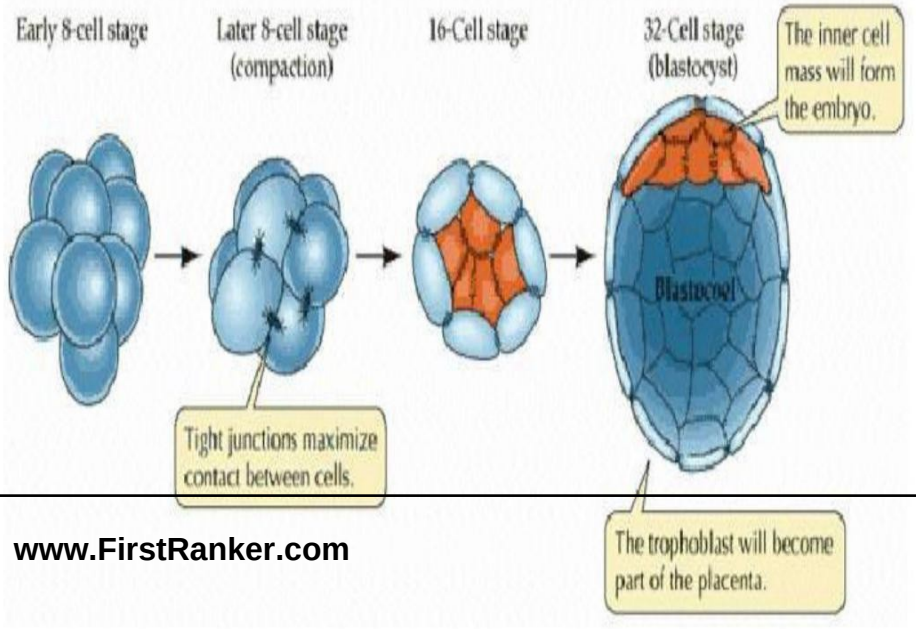
- **Embryonic Period**
- **Fetal Period**

Embryonic Period/ Period of Organogenesis: 3-8 weeks

Process of progressing from a single cell till the formation of organ primordia





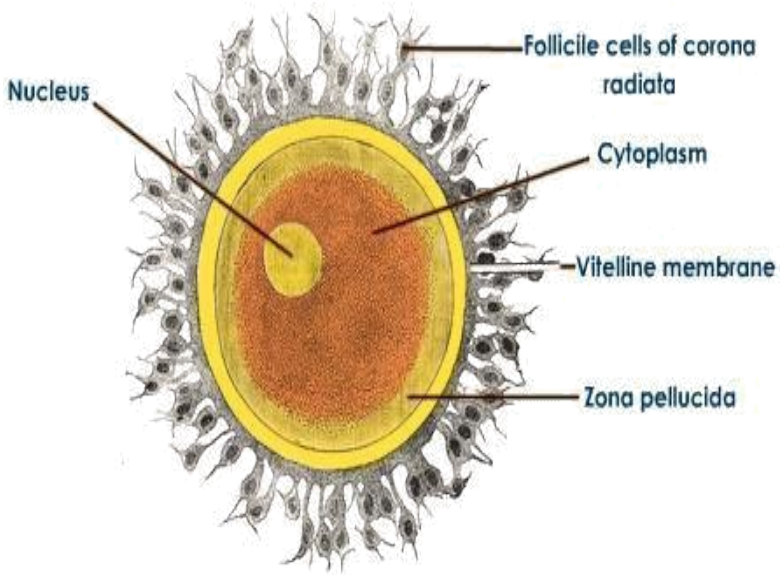


Fetal Period: 9th week – birth

Differentiation continues while the fetus grows and gains weight

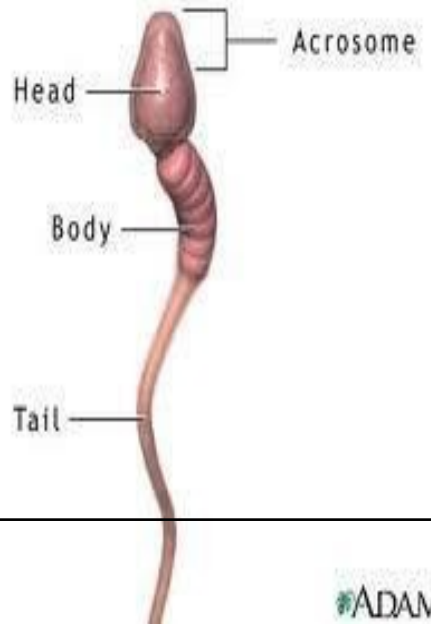
EMBRYOLOGICAL TERMINOLOGY

- **Ovum** derived from the Latin word meaning egg



- **Sperm**

  Derived from the Greek word sperma meaning seed

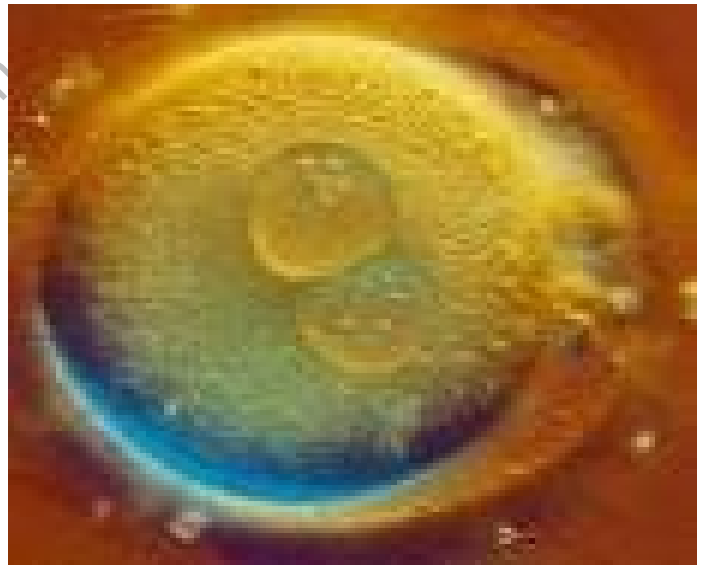


- **Zygote**

  Cell that results from the union of oocyte and sperm during fertilization

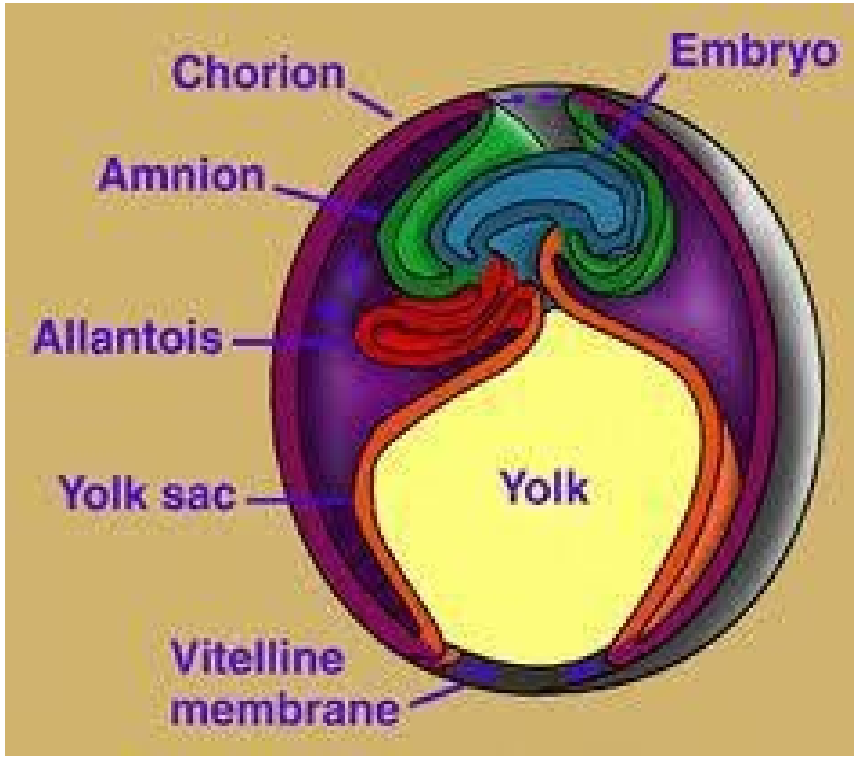
- **Embryo**

  The developing human in its early stages of development (3-8 week)

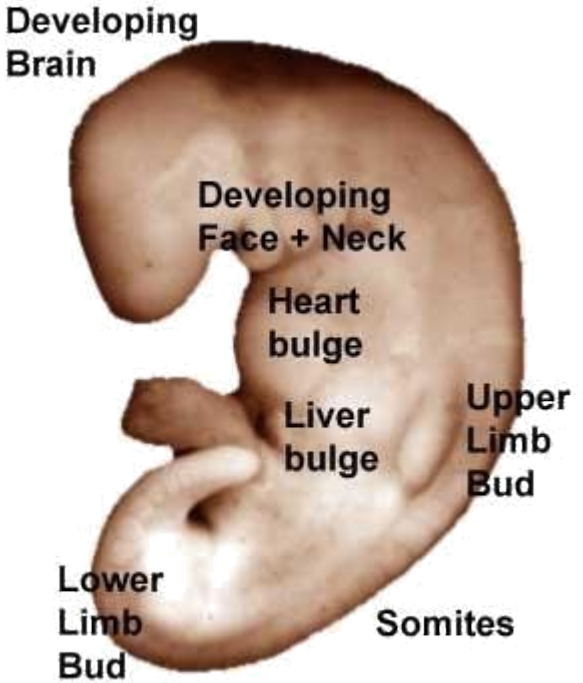


- **Conceptus**

Embryo and its adnexa i.e. all structures that develop from zygote



- **Primordium / anlage / rudiment**: The first discernible indication of organ or structure



Stage 13 Embryo

- **Fetus** (unborn offspring) : The developing human after the embryonic period (9th week - birth)

POSTNATAL PERIOD

- **Infancy:** 1st year after birth
- **Neonate**: birth -1 month
- **Childhood** : A period from 13th month till puberty
- **Puberty** (period of development of sex characteristics)
  In females-12-15 years
  In males: 13-16 years
- **Adolescence** (period of rapid physical and sexual maturity): 11-19 years
- **Adult hood** (Attainment of full growth and maturity)
  18-21 years
- There after developmental changes occur very slowly.

- Development does not stop at birth. Important changes in addition to growth occurs after birth such as development of teeth and development of female breasts.

- **The brain triples in weight b/w birth and 16 years; most developmental changes are completed by the age of 25.**