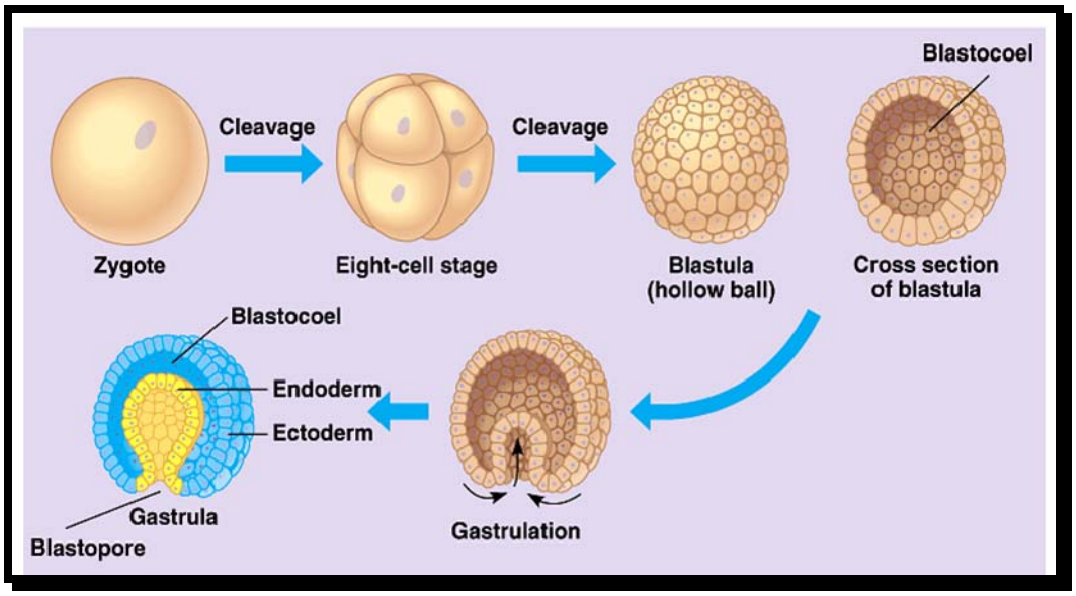
Fertilization

Fertilization is the union of a monoploid (n) sperm nucleus with a monoploid (n) egg nucleus resulting in a diploid (2n) **zygote.**

Stages of Embryonic Development

1. **Cleavage:**
   - Zygote undergoes a series of mitotic cell divisions without growth
2. **Blastula:**
   - Hollow ball-type of structure that is made up of a single layer of cells
3. **Gastrula:**
   - One side of the blastula becomes indented forming the gastrula
   - **Ectoderm** – outer layer
   - **Endoderm** – inner layer
   - **Mesoderm** – a third layer of cells forms between the endoderm and ectoderm
4. **Differentiation:**
   - The three layers differentiate (cells take on specific functions)
   - Ectoderm becomes nervous system and skin
   - Endoderm becomes lining of digestive and respiratory tracts and parts of pancreas and liver.
   - Mesoderm becomes muscles, circulatory system, skeleton, excretory system, and gonads.
5. **Growth:**
   - Once differentiation occurs, the cells begin to increase in number and size



External Fertilization

- The union of sperm and egg outside the body of the female.
- Generally occurs in a watery environment
- Characteristic of reproduction in fish, amphibians, and other water organisms
- **Large numbers of eggs and sperm are released into the water** at the same time to increase the chances that fertilization will take place and to ensure that at least some of the fertilized eggs will survive to adulthood

Internal Fertilization

- The union of sperm and egg inside the moist reproductive tract of the female
- More common of land animals such as birds and mammals
- Internal fertilization requires that fewer eggs to be fertilized at one time since the chances of fertilization are much greater and the zygotes are not exposed to the dangers that externally fertilized eggs face.

External Development

1. **In Water:**
   - Eggs of organisms of water organisms such as fish and amphibians have external fertilization and development in an aquatic environment with little or no parental care
   - Source of food is **yolk** stored in egg.
2. **On Land:**
   - Eggs of birds, reptiles, and a few mammals have internal fertilization and external development on land
   - Embryo's source of food is **yolk**
   - Adaptations of external development include a shell for protection (permits gas exchange) and small membranes that provide a favorable environment for embryonic development.

Internal Development (development of the embryo inside the parent)

1. **Mammals:**
   a. ***Monotremes***
      - Egg-laying mammals
      - Internal fertilization, external development
      - Ex: duckbill platypus

   b. **Marsupials**
      - Internal fertilization with some internal development
      - During internal development, embryonic nourishment comes from egg yolk – there is no direct nourishment from the parent
      - Embryo is "born" at a pre-mature stage and must travel on its own up the ventral side of the mother and enter the mother's external pouch
      - Remainder of development in pouch where embryo-fetus feed on milk from mother's mammary glands
      - Ex: kangaroos, opossums, koalas

   c. **Placental**
      - Embryos develop internally within the uterus
      - Eggs of mammals are relatively small because they contain little yolk
      - Placenta: formed from embryonic AND maternal tissue
        -- **separate maternal blood and embryonic blood**
        --exchange of nutrients, wastes, and other respiratory gases between mother and embryo through the placenta by diffusion and active transport.
      - **Umbilical cord** contains blood vessels
        --attaches embryo to placenta
        --carries oxygen and nutrients to embryo; carries carbon dioxide, urea and other wastes from embryo to placenta to be excreted by mother