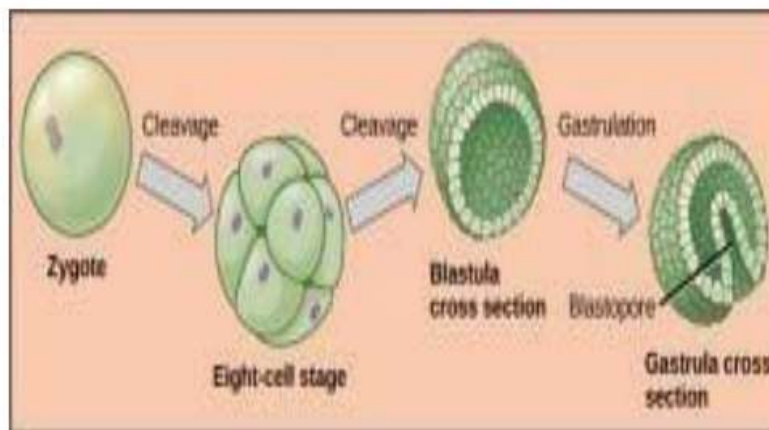


## Gastrulation in Frog up to the formation of three germinal layers

Gastrulation is the process by which a blastula is converted into a gastrula. Blastula is hollow ball of cell. By the end of gastrulation, it is converted into a three-layered embryo made of ectoderm, mesoderm and endoderm often enclosing an archenteron.



**Fig: The image above shows the process of transformation from a single-celled zygote to a gastrula.**

At a specific region below the equator the blastoderm cells assume an elongated bottle like shape. They move toward the interior of the blastula. As the cells move further inside, an invagination happens.

A deepening of the invagination results in a cavity called the archenteron or gastrocoel. The opening of the archenteron on the surface of the blastula is called the blastopore.

Gastrulation includes three kinds of morphogenetic movements of cells namely-

- **Epiboly:** Migration and spreading of micromeres over the embryo is known as epiboly. A process that occurs during gastrulation in vertebrates, in which cells on one side of the blastula grow over and surround the remaining cells and yolk and eventually form the ectoderm.
- **Invagination:** Invagination of prospective endoderm cells occurs below equator, exactly below the midpoint of gray crescent of blastula. It results in the formation of a slit later giving rise to blastopore.
- **Involution:** The inward movement of the exterior cells through the blastoporal region is called involution. The involution results in the positioning of chorda-mesodermal cells and pharyngeal endodermal cells.

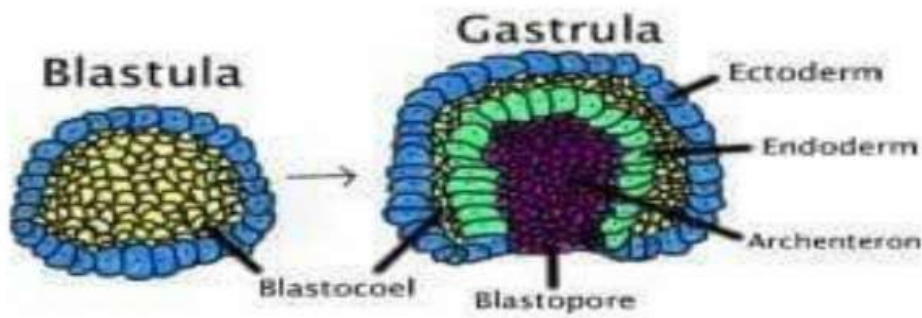


Fig: The image above shows how gastrulation changes the number of cell layers from one to three.

The mesodermal cells occupy the region between inner endodermal and outer ectodermal cells. While the exterior chorda-mesodermal cell involute inside, their place is taken up by the ectoderm.

The expansion of the ectoderm is due to epiboly. Epiboly causes overlapping or '*the roofing over*' of the gastrula by the ectoderm.

The blastopore is gradually covered by certain endoderm cells. The closing cells of the blastopore constitute the *yolk-plug*. Gradually the yolk-plug withdraws to the interior and the blastopore gets reduced into a narrow slit.

The process of gastrulation converts the blastula into a spherical, bi-laterally symmetrical, triploblastic gastrula. Gradually the gastrula undergoes the process of tubulation or neurulation to become a neurula.

### **Neurulation**

The process of neurulation is the formation of a neural tube. However during this process mesoderm and endoderm also undergo differentiation. During neurulation the embryo lengthens along the antero-posterior axis. The dorsal side of the gastrula is lined by ectodermal cells.

The presumptive area of the nervous system gets differentiated from the rest of ectoderm. It remains as medullary plate or neural plate.

The neural plate later thickens and it gets raised above the general level as ridges called neural folds.

In the middle of the neural fold a neural groove appears. The neural groove deepens inside, the neural folds above the groove. The neural groove gets converted into a neural tube. This tube gets detached from the surface. The neural tube remains as the prospective nervous system. The embryo at this stage



is called the neurula. During neurulation, the tubulation of chorda-mesoderm and tubulation of endoderm also happen. The post-neurular development of frog involves the formation of all body organs.