BLASTULA

1. The cleavage is the fractionating process which splits zygote or fertilized egg into smaller cells called *blastomeres.*
2. These cells are formed in the typical doubling sequence 2,4,8,16,32,64 etc.
3. This geometrical regularity exists only in the early developmental stages.
4. Latter on the process of cleavage becomes entirely irregular.
5. During the early cleavage stages the blastomeres maintain the spherical shape and the loosely arranged blastomeres from the structure called *morula.*
6. Later on the morula develops into the embryonic stage called *blastula.*

Blastula: It is a hollow sphere of cells or blastomeres produced during the development of an embryo by repeated cleavage of a fertilized egg. The cells of the *blastula* form an epithelial (covering) layer, called the blastoderm, enclosing a fluid-filled cavity, the blastocoel.

Morulation and Morula

Isolecithal or hololecithal eggs usually cleave to form a population of equal sized cells in a tight cluster called morula. The term morula is normally applied to most early cleavage stages. It is referred as cluster of blastomeres tightly packed within the fertilization membrane.

The shape of morula depends upon many factors like

Primarily yolk determines how newly formed blastomeres get arranged into a cell sheet.

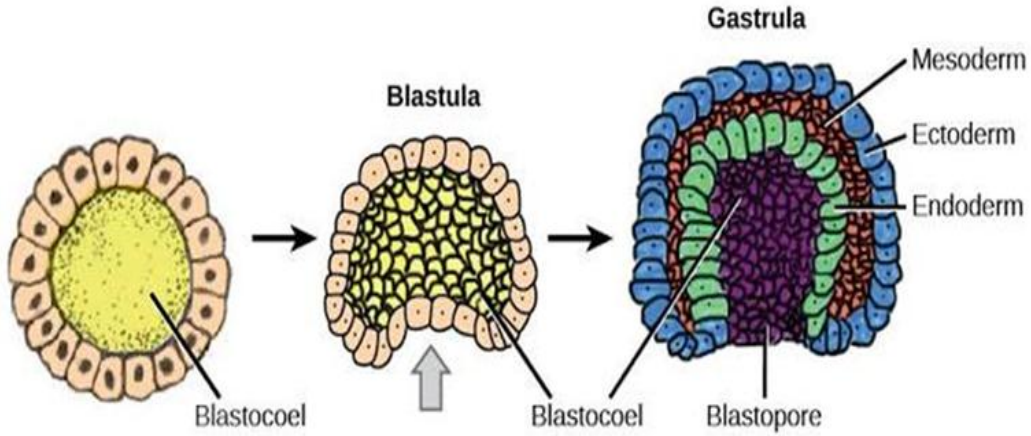
Secondarily mechanical forces exerted by the surrounding fertilization membrane and hyaline layers as well as contact relationship established between the blastomeres such as tight conduction and cytoplasmic bridges and intracellular cementing substances provide cohesion in blastomeres and contribute to the shape of embryo i.e. morula.

BLASTULATION AND BLASTULA

As the cleavage proceeds the number of blastomeres of the morula increases and the blastomeres undergo rearrangement. This cells arrange themselves into a true epithelium. It is also called as *blastoderm.* A fluid filled space or cavity called blastocoele appears in the centre of the blastoderm. This hollow, spherical and uniepithelial thick embryonic stage is called *Blastula* and the process of its formation is called *Blastulation.*

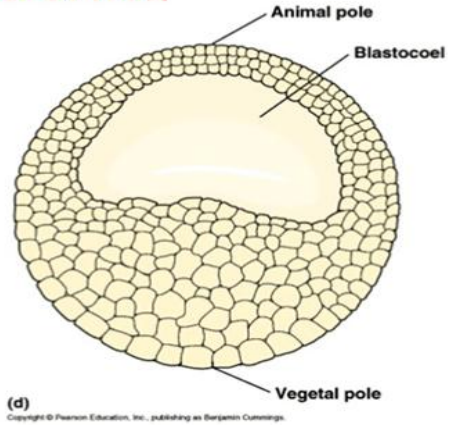
In case of telolecithal eggs where yolk is more, the blastomeres are of two types namely micromeres and megemeres. Large number of micromeres are formed at the animal pole while vegetal pole has only few large megemeres eg frog and avian eggs.

In case of heavily telolecithal eggs eg. Chick, Reptile, Fish, the process of Blastulation is restricted to the germinal disc only. This cells in the central part of germinal disc become multilayered and get separated from underlying yolk .



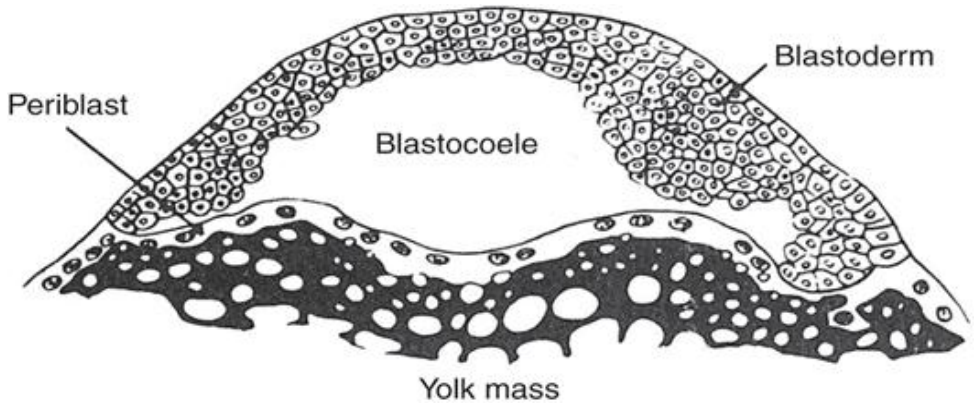
Blastula of Amphioxus

Blastula of frog

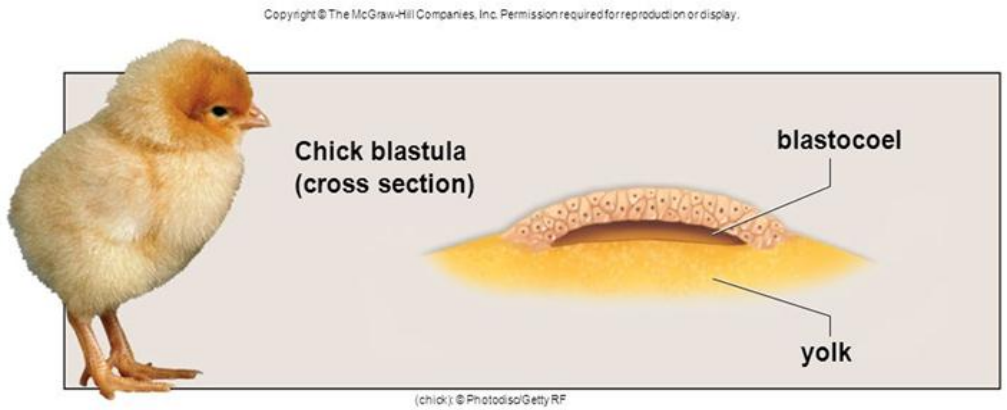


Blastula of Frog

Chick Blastula



Blastula of Fish



Blastula of Chick

Due to separation of cells from the yolk in the central part of the germinal disc a clear space called *submarginal cavity* develops between the blastomeres and yolk.

The roof of submarginal cavity is called *epiblast.*

The floor of the submarginal cavity is formed of yolk.

Few blastomeres from the marginal region of the germinal disc migrate into the submerginal cavity and form thin layer called *hypoblast.*

The cavity between epiblast and hypoblast is called the *blastocoele.*

THE PROCESS OF BLASTULATION

The mechanism of Blastulation is explained by the following two theories.

1. Hydrostatic Pressure Theory:

This theory was suggested by K. Dan in 1960 and according to it, the hydrostatic pressure within the blastocoele forces and cleaving cells to periphery. According to this view fine cytoplasmic processes penetrate the enveloping hyaline layer creating a cohesive expanding surface. As cell number increases the cells becomes smaller they secrete fluids into extracellular spaces and these fluids accumulate in a central cavity. Hydrostatic pressure builds up in the cavity, collides with outermost cells adhering to the hyaline layer and generate a hollow sphere.

2. Surface Tension Theory:

This theory was proposed by Gustafson and Wolpert (1967). According to this theory the formation and expansion of blastocoele result from the manner in which the blastomeres are packed in a blastula. The outer surface of the outer cell layer increases and the cells round up, divide and produce two rounded cells. This produce rhythemic tensions and divisions are translated into pulsations of contractions and expansions. After a division tension is reduced and cell contact is increased.

Blastulation in Isolecithal Egg: In microlecithal and Isolecithal egg of Amphioxus the blastomeres at the end of cleavage arrange themselves in a single cell thick simple columnar epithelium enclosing the centrally located blastocoele. These cells are not exactly equal size due to slight yolk inhibition. Therefore the epithelium is thicker at vegetal pole and thinner at animal pole.

Blastulation in Moderately Telolecithal Eggs: The yolk has an unequal distribution, eg. Egg of frog and other amphibians. This result in the displacement of the horizontal cleavage towards the animal pole and retardation of cleavage rate in the yolk laden vegetal half. The blastomeres of vegetal half are much larger than those of the animal half. The small micromeres tend to form the roof of the blastocoele while the large macromeres form the floor of blastocoele. In such a blastula, the roof of blastula is made up of two or more layers of blastomeres.

Blastulation in Heavily Telolecithal Eggs: In the eggs of fishes, reptiles and birds at the end of segmentation, the embryo has arrived at the morula stage which consists of a disc shaped mass of cells lying applied to the yolk. Later on the central area of the blastodisc becomes separated from the underlying yolk and enclosed between itself and the uncleaved residue of the egg a fluid cavity called subgerminal cavity.

The blastomeres of central area are further divided by many vertical and horizontal cleavage furrows so that the blastodisc has 4 to 5 cells thick central region.

The cells of the periphery (marginal cells) and the syncytial layer lying under the submarginal cavity remain closely to the yolk and is called *periplast.*

The periplast area of the discoblastula is opaque because the large yolk laden blastomeres rest directly on the underlying yolk. This outer zone is called as *area opaca*.

The central masses of blastomeres overline the fluid filled subgerminal cavity are smaller and relatively free from the yolk appear translucent . They constitute the area called *area pellucida*.

The larger yolk laden blastomeres of the area pellucida segregate from the blastodisc and move inward in the subgerminal space one by one or in loose clusters and form a less organized thin flat epithelial layer called the *hypoblast.*

The yolk poor and small size blastomeres left behind at the surface as a thin superficial layer known as the *epiblast.*

TYPES OF BLASTULAE

1. **COELOBLASTULA:** The blastula of Echinoderms and Amphioxus is called coeloblastula. It is a hollow and blastocoele is filled with mucopoly saccharides and blastoderm is of single layer of cells.
2. **STEREOBLASTULA:** It is the solid blastula because there is no blastocoele cavity. This type of blastula is formed due to spiral cleavage in Annelids, Molluscs, Planarians. The smaller micromeres form the cluster towards the animal pole where as the larger macromeres are towards the vegetal pole.
3. **PERIBLASTULA OR SUPERFICIAL BLASTULA:** It is formed in the insect eggs due to superficial cleavage and there is no blastocoele in it. The nuclei collect in the peripheral layer. The cavity is present but filled with yolk from the beginning of the cleavage.
4. **DISCOBLASTULA:** This blastula is found in the yolky eggs of fishes, reptiles and birds. It is called discoblastula because it appears at the animal pole in the form of small multilayered flat disc separated from the yolk by a narrow submarginal cavity.

5. AMPHIBLASTULA: This blastula is formed by two different types of blastomeres. The best example of blastula is Sycon sponge. Anterior half part of blastula is formed by flagellated micromere cells while the posterior half part is formed by large rounded granular macromeres.

6. BLASTOCYST: It is found in mammals by regular cleavage. The small cavity is called blastocoele. Then it becomes larger. The cluster of cells distinct into two groups called trophoblast cells or nutritive and formative cells. The trophoblast cells are epithelium like layer which is surrounding the blastocoele cavity and formative cells form inner mass at one pole.

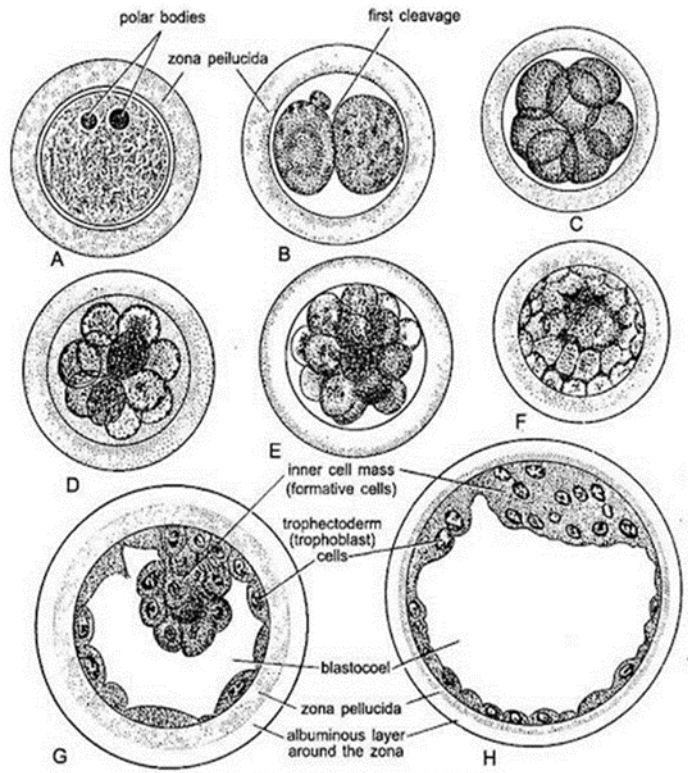


Fig. 39.1. Early cleavages of rabbit.