

Study material of the course-**Veterinary Anatomy**  
(For B.V.Sc. & A.H., 1<sup>st</sup> Year batch)

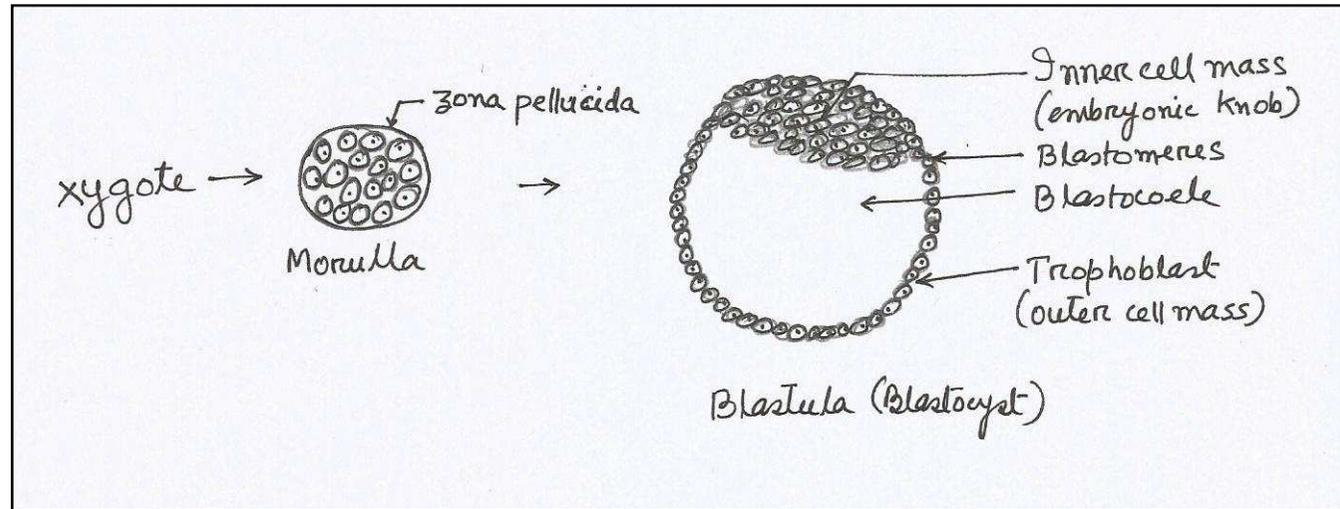
**Topic: CLEAVAGE & BLASTULATION**

The series of cell divisions that transform the single celled zygote into a **multicellular** embryonic stage-the blastula is called *cleavage* or *segmentation*. The mitotic divisions during this phase are called cleavage divisions and the resulting daughter cells are called *blastomeres*.

# Characteristics of Cleavage

- All divisions of the cleavage are mitotic and occur consecutively.
- During cleavage, there is no growth in the resulting blastomeres. The cells go on diminishing in size.
- The general shape of the embryo does not change, except for the formation of a cavity among the cleavage cells, called *blastocoele*.
- A great increase in the synthesis of DNA takes place in this period.

- The ratio of nucleus to cytoplasm is very low at the beginning of the cleavage, but later they resemble somatic cells.
- During cleavage, oxygen consumption is greatly increased.
- The constituent parts of the ooplasm remain unaltered during cleavage.
- Cleavage ends when the blastocoele is formed.



**Fig.** Cleavage in Mammals

The major types of cleavage have been distinguished on the basis of the amount and distribution of the yolk in the egg as detailed below-

- **Holoblastic cleavage:**

- In this type of cleavage, the whole of the fertilized ovum is involved in the production of the blastomeres. This occurs due to the presence of scanty amount of deutoplasm in the ovum. It is called *complete cleavage*.
- It is of two types-

**Equal holoblastic cleavage:** Here, the blastomeres are of equal . *eg.* All placental mammals.

**Unequal holoblastic cleavage:** here, the blastomeres are of various sizes. *eg.* *Amphibians*.

- **Meroblastic cleavage:** When the deutoplasm is abundant and only a part of fertilized ovum is involved in the cleavage division, the process is called *meroblastic division*.

It is of two types-

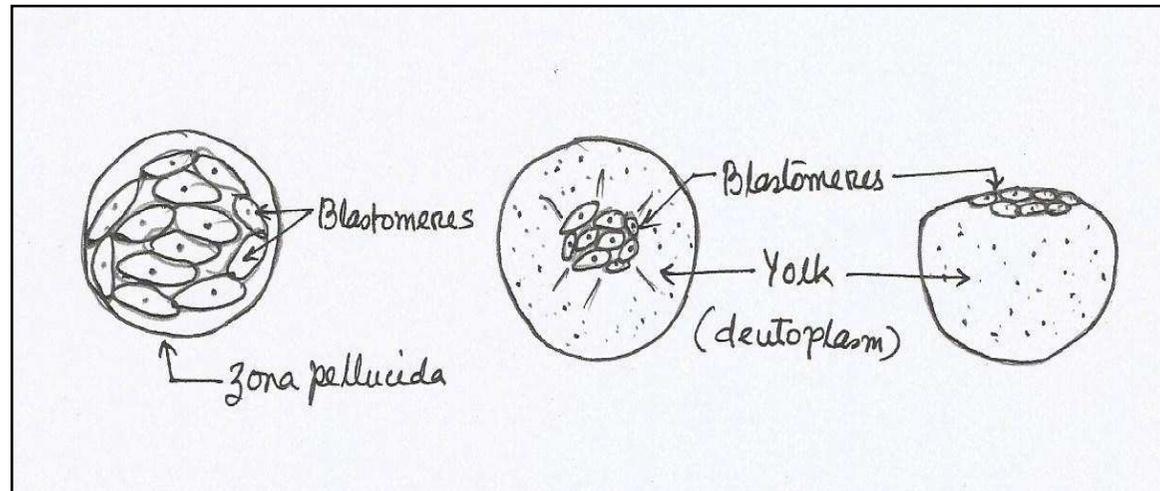
**Discoidal cleavage:** It occurs in yolky macrolecithel (telolecithel) eggs here the cleavage is limited to animal pole only. *eg.* Birds and reptiles..

**Superficial Cleavage:** When the cleavage is limited to peripheral cytoplasm, it is called superficial meroblastic cleavage. *eg.* *Arthropodes*.

Cleavage results in the formation of *Morulla and Blastula*.

# Morulla

It is a stage of cleavage where the blastomeres are completely arranged inside the **zona pellucida** giving a **mulberry fruit shape**, is called a morulla. It is the stage before blastocoele is formed. The blastomeres of a morulla tend to assume a spherical shape.



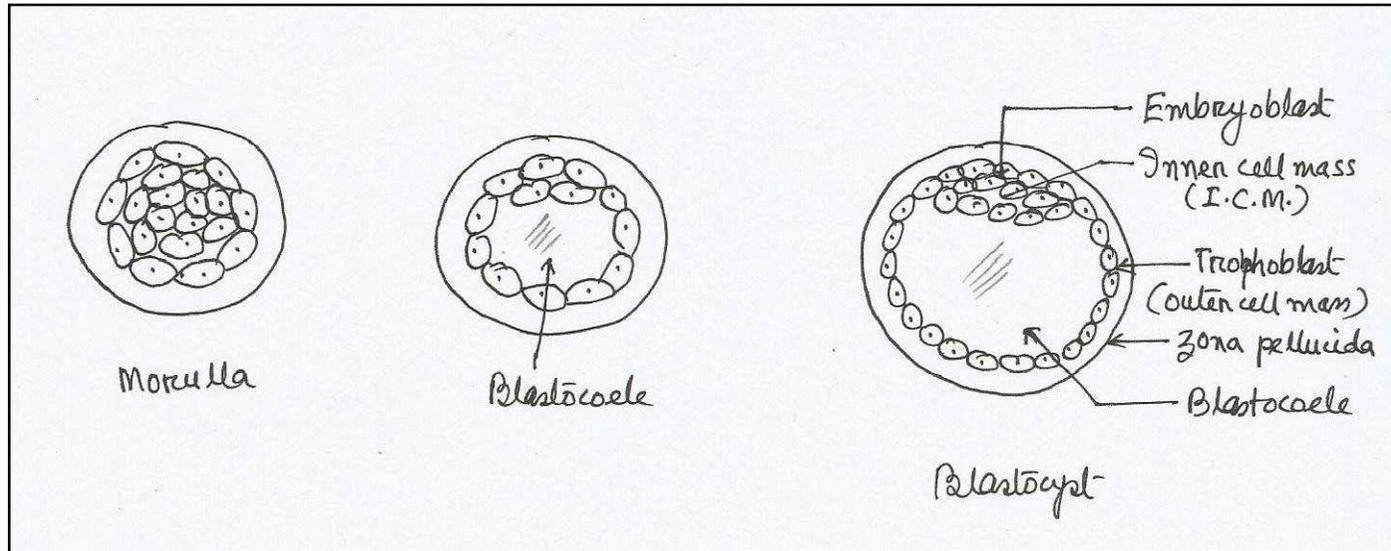
**Fig.** Morulla of mammals

**Fig.** Morulla of birds

The 32 cell stage embryo is most important and known as stage of 5<sup>th</sup> *generation mitosis*. This stage of embryo is used for *embryo transfer* in ETT (Embryo Transfer Technology). At this stage, the embryo reaches the uterus. The central cell mass of the morulla generally gives rise to the embryo proper and the peripheral cells form the *protective* and *nutritive* coverings of the embryo.

# Blastula

- At the end of cleavage, the embryo consists of a hollow sphere of cells in holoblastic type of cleavage (in mammals). In the uterine cavity, the blastomeres continue to divide and fluid from the lumen of the uterus enters inside the embryo through the *zona pellucida* and form a central fluid filled cavity which gradually separates the blastomeres into an *inner cell mass*(ICM) and an *outer cell mass* (OCM). The blastomeres of the inner cell mass are called the *embryoblasts* and the cells of the outer cell mass are called the *trophoblasts*.



**Fig.** Formation of Blastula (Blastulation)

# Blastulation:

- The development of the blastula is called **blastulation**. The types of blastula varies among species of animals depending on egg size, amount and pattern of distribution of yolk, rates and patterns of cleavage, etc. They are summarized below.

- **A. Blastula formed out of Holoblastic cleavage:**

**Stereoblastula:** This type of blastula is composed of compactly or densely packed , but larger sized, relatively small number of blastomeres. The blastocoele is very small or virtually absent. **eg.** Insects.

**Coeloblastula:** This type of blastula consists of one or several layers of cells arranged around a **large blastocoele**. **eg.** Amphibians.

- **Blastula formed out of Meroblastic cleavage:**

**Periblastula:** Here, there is no cavity comparable to the blastocoele. It consists of single layer of epithelial cells- the *blastoderm*. *eg.* Insects.

**Discoblastula:** These are formed where eggs are highly telolecithal. They undergo discoidal type of cleavage which results in the formation of a *blastodisc* on the top of the yolk. The blastodisc consists of several layers of cells. *eg.* Birds.

# Cleavage in chicks

- The eggs of the hen are *megalecithal* type. Here, the cleavage is of meroblastic types and is *incomplete* as the yolk never divides. It is confined to only dorsal part of the ovum involving the cytoplasm and nucleus. The zygote divides and as a result, a layer of cells is produced which forms a cap over the yolk with little space between it and the underlying yolk. This layer of cells is called *blastodisc*.

The blastodisc is divided into three areas-

*Area pellucida*

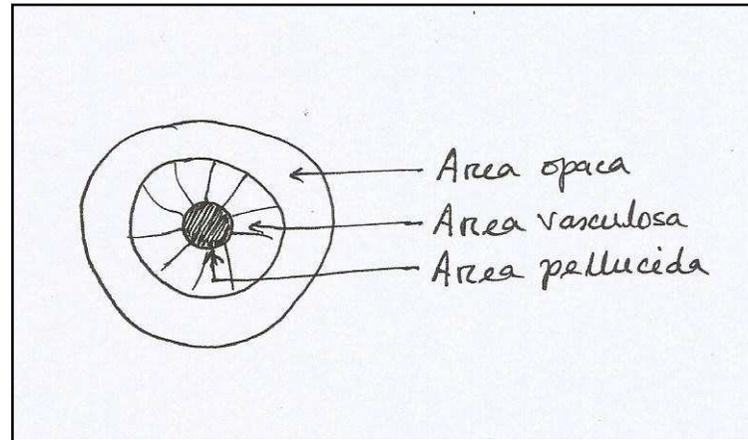
innermost layer

*Area opaca*

Outermost layer

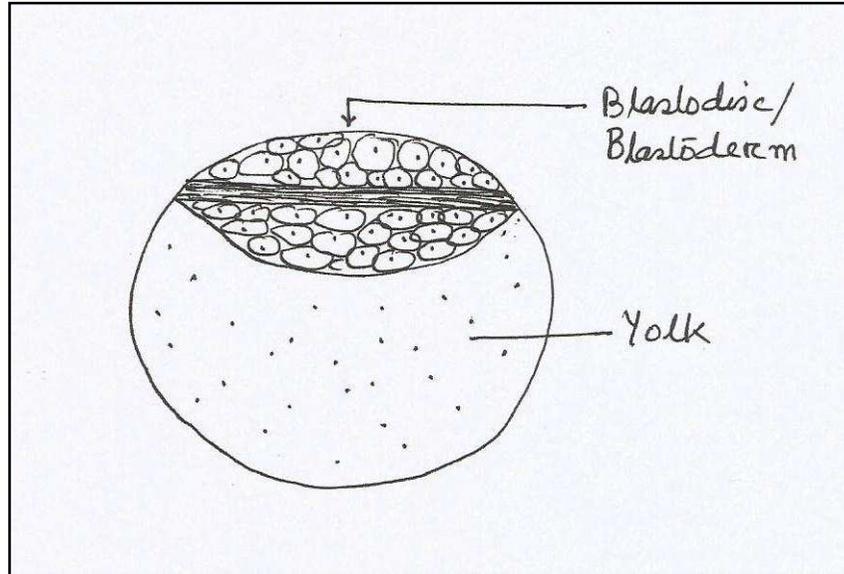
*Area vasculosa*

Middle layer



**Fig.** Layers of blastodisc

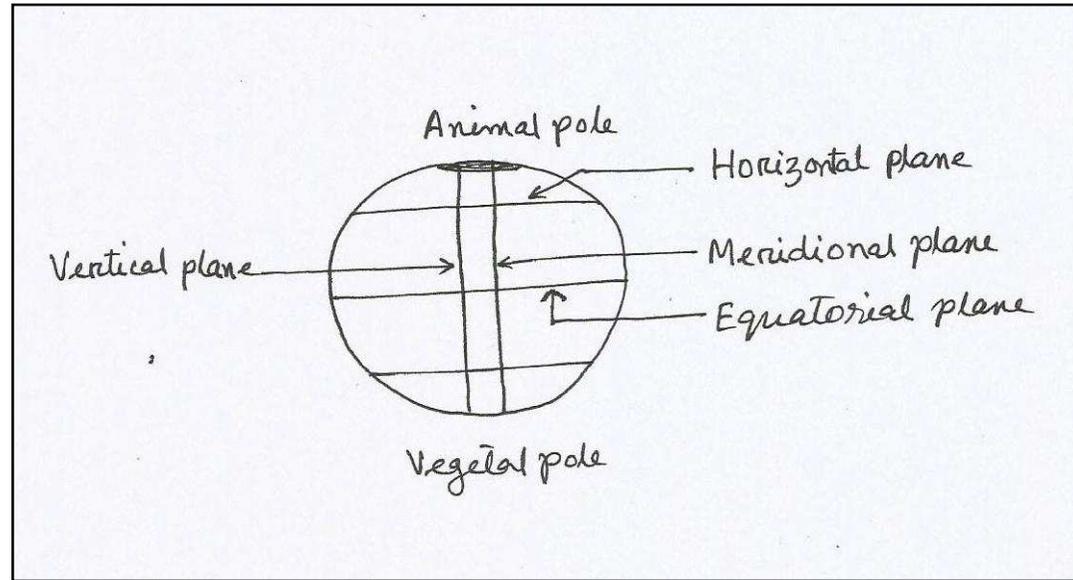
The space between the blastoderm (blastodisc) and the yolk is called the *blastocoele*.



**Fig.** Discoblastula in chick (birds)

# The planes of Cleavage

- The cleavage is initiated by the appearance of a constriction or groove called *cleavage furrow*, which divides the egg at different planes. There are **four** important planes of cleavage as mentioned below-
- **Meridional Plane:** When cleavage furrow bisects both the poles of the egg, passing through the animal-vegetal axis, the plane is called meridional plane.
- **Vertical plane:** It is a furrow which passes from the animal pole to the vegetal pole, but does not pass through the median axis of the egg, instead, it is oriented towards one side of the axis.
- **Equatorial plane:** This plane of cleavage bisects the egg at right angles to the median axis half way between the animal and vegetal poles.
- **Horizontal plane:** It resembles the equatorial plane, but it passes either above (towards the animal pole) or below (towards the vegetal pole) of the equator of the egg.



**Fig.** Planes of Cleavage