**Dr. Mrs. S. Vairamani M.Sc., M.Ed., M.Phil., Ph.D., (Zoo)., Ph.D.,(Edu).,**

**Assistant Professor of Zoology**

**D.G.G.A.for Women, Mayiladuthurai**

[**babavairamani@gmail.com**](mailto:babavairamani@gmail.com) **9486386923**

**Cleavage**

**Synopsis**

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**Introducation**

* **1. Embryology - the science dealing with the embryo and its development**
* **2. EMBRYOGENY/EMBRYOGENESIS - the development of the embryo**
* **3. EMBRYO - the juvenile stage of an animal while it is contained in the egg (within the egg membranes) or in the maternal body**
* **4. Types of eggs based on the amount of yolk they contain:**
  + **i. MICROLECITHAL (OLIGOLECITHAL) - little yolk present (amphioxus, marsupial and placental mammals)**
  + **ii. MESOLECITHAL - moderate amounts of yolk present (lamprey, sturgeon, lungfish, and amphibians)**

**iii.. MACROLECITHAL (POLYLECITHAL) - large amounts of yolk present (hagfish, sharks, rays, teleost fish, reptiles, birds, and monotreme mammals)**

**5. Types of eggs based on how the yolk is distributed in it:**

**The pole where the yolk is concentrated is called vegetalpole, the opposite end (with nucleus) is the animal pole.**

1. **Isolecithal (homolecithal) - the yolk is diffused throughout the egg (true for microlecithal eggs) microscopic eggs of mammals, amphioxus**
2. **Telolecithal - the yolk is concentrated towards one side of the egg (true for mesolecithal and macrolecithal eggs) : fishes, reptiles amphibians, birds**

* **Embryology: Embryogenesis and Organogenesis**
* **Embryogenesis – development of primary germ layers and their locations Organogenesis – formation of the different organs**

**Stages of Embryogenesis**

**Fertilization zygote cleavage Blastulation Gastrulation Neurulation organ formation**

1. **What is cleavage?**

* **Cleavage is the division of zygote into many smaller cellular units called blastomeres.**
* **The cleavage starts 60 to 90 minutes after fertilization**

1. **Blastomeres**

* **Blastomeres are the smaller cellular units caused by cleavage.**
* **They are of two types.**
* **Micromeres are smaller in size and Macromeres are larger in size**

1. **Blastula**

* **Blastula is an embryonic stage develops as a result of cleavage where zygote divides into many smaller cellular units called blastomeres.**
* **They are of two types.**
* **Micromeres are smaller in size and Macromeres are larger in size**
* **A cavity called blastocoel is present among the blastomeres.**
* **This blastocoel is filled with a fluid called blastocoel jelly**
* **The blastomeres are arranged in one or more layers around the cavity called blastoderm**
* **This embryo stage is called blastula**
* **The development of the blastula is called blastulation**

1. **Salient features of cleavage**

* **The fertilized egg undergoes mitosis to produce thousands of cells called blastomeres**
* **Cleavage produces a solid mass of cells called Morula Ex. Mammals**
* **Cleavage produces a hollow sphere of cells called blastula**
* **These number of cells helps to construct tissues and ofgans**
* **During cleavage, the embryo does not grow**
* **The shape of the embryo also does not change during cleavage**
* **Amount of DNA also increases during cleavage**

1. **Planes of cleavage**

* **Cleavage is initiated by forming a groove or constriction called cleavage furrow**
* **The cleavage furrow divides the egg at different angles or planes**
* **There are 4 main planes of cleavage**
* **They are**

1. **Meridional plane**
2. **Vertical plane**
3. **Equatorial plane**
4. **Latitudinal lane**
5. **Meridional plane**

**If the cleavage furrow bisects both the poles of the egg passing through the polar axis, then the cleavage plane is said to be meridional**

1. **Vertical plane**

**The cleavage furrow passes from the animal pole to the vegetal pole but not through the median axis of the egg**

1. **Equatorial plane**

**The equatorial plane bisects the egg at right angles to the median axis and half way between the animal and vegetal poles Ex: sea urchin**

1. **Latitudinal plane**

**This plane cuts the egg at right angles to the medianaxis but passes either above or below the equator of the egg**

1. **Patterns of cleavage**

**There are mainly two types of cleavage. They are Holoblastic and Meroblastic cleavage**

1. **A. Holoblastic cleavage(Complete cleavage)**

* **Here, the entire egg divides completely. It is otherwise called total or complete cleavage**
* **When the blastomeres ae equal in size then it is called equal cleavage**
* **When the blastomeres are unequal in size then the cleavage is called unequal cleavage**
* **Holoblastic cleavage is again divided into 4 types depending upon the symmetry of the cleavage**
* **Holoblastic cleavage is further divided into**

1. **Radialcleavage**

* **Here, the blastomeres are arranged radially around the central axis of the egg and the cleavage produces radially symmetrical embryos called radial cleavage**

1. **Spiral cleavage**

* **It is a holoblastic cleavage where the new blastomeres are slightly displaced giving a spiral shape to the embryo**
* **In spiral cleavage the blastomees are spirally arranged**

1. **Biradial cleavage**

* **It is seen in Ctenophora**
* **The first two cleavage planes are meridional and the third cleavage is vertical**

1. **Rotational cleavage**

* **Ex: Mammals**
* **This cleavage is unusual**
* **First cleavage is meridional**
* **In the second cleavage the cleavage plane in one of the two blastosmeres is rotated to 90 0with respect to the polar axis**

**I B.Meroblastic cleavage (Incomplete cleavage)**

**Here, a portion of the egg divides . Hence it is called partial or incomplete cleavage. Ex: Telolecithal and megalecithal eggs. The meroblastic cleavage is of two types. They are**

1. **Discoidal cleavage**

**Ex: Fishes, Reptiles and birds**

**Here the cytoplasm is placed at the animal pole as a disc called blastodisc and this disc only divides. Hence it is called discoidal cleavage**

1. **Superficial cleavage**

**Ex: Insects**

**Here the cleavage occurs only in the surface layer of the egg and not upto the central yolk**

1. **Cleavage is further divided into 2 types on the basis of potentiality of the egg blastomere. They are**
2. **Determinate cleavage**

**Here, the predetermined blastomeres develop into definite organs called Determinate cleavage**

**This resulting embryo contains different types of predetermined blastomeres.**

**Such an embryo is called Mosaic embryo and the development is called Mosaic development**

**The egg producing the mosaic embryo is called mosaic egg**

1. **Indeterminate cleavage**

**Here, the fate of each part or blastomere is not already determined**

**The indeterminate cleavage is also called regulative development**

**Ex: Vertebrates**

1. **Factors affecting cleavage**

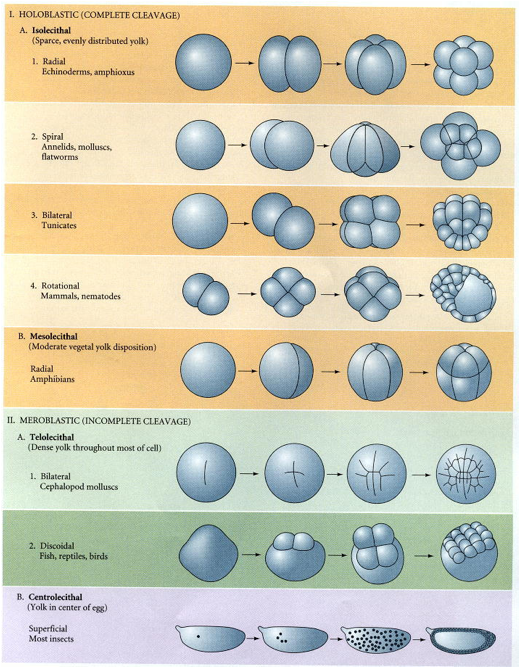
**The rate and nature of cleavage are much affected by factors like Light, Temperature, medium, amount of yolk, cytoplasmic organisations, mitosis, etc.,**

1. **Influence of yolk on cleavage**

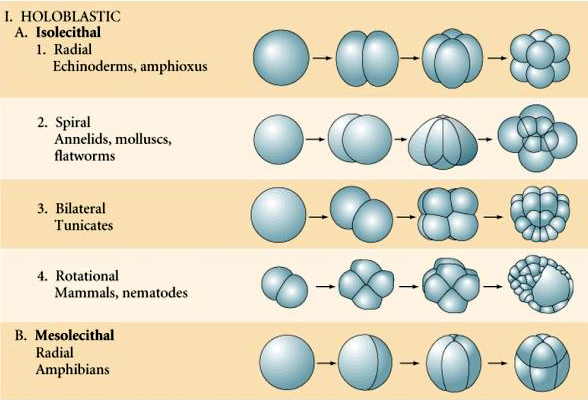
**Yolk influences the cleavage in 2 ways**

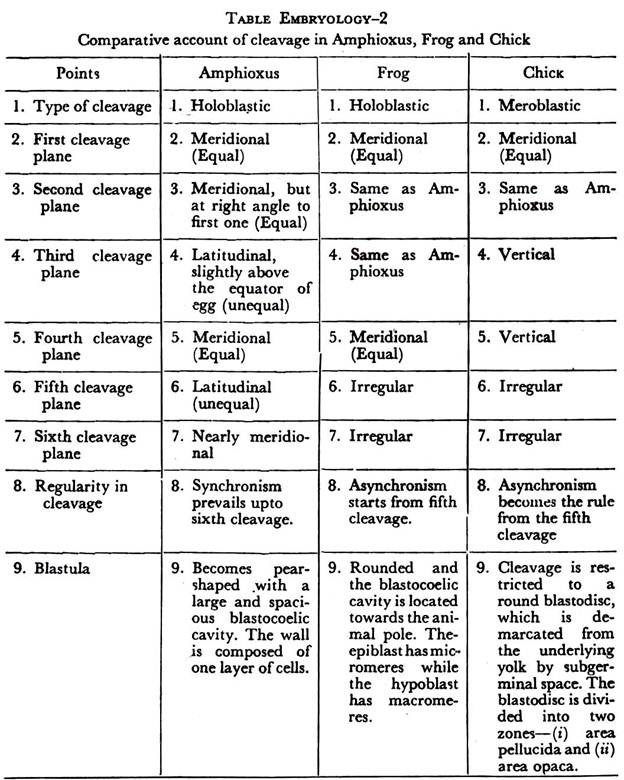
1. **It affects the rate of cleavage and**
2. **It determines the pattern of cleavage**
3. **Inflence of organisation of egg cytoplasm on cleavage**
4. **The rate of cleavage and the size of the blastomeres are also determined by the cytoplasm**
5. **Ex: the larger macromeres divide at a faster rate and the smaller blastosmeres at a slower rate**
6. **Influence of mitosis on cleavage**
7. **Nuclear division and**
8. **Cytoplasmic division**

**Ex: In the early development of chick embryo, cytoplasmic division occurs without involving nuclear division.**



**Types of cleavage**

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