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Topic: Types and Patterns of Cleavage

Types and Patterns of Cleavage

In embryology, cleavage is the division of cells in the early embryo. The process follows fertilization, with the transfer being triggered by the activation of a cyclin-dependent kinase complex. The zygotes of many species undergo rapid cell cycles with no significant overall growth, producing a cluster of cells the same size as the original zygote. The different cells derived from cleavage are called blastomeres and form a compact mass called the morula. Cleavage ends with the formation of the blastula.

Depending on amount of yolk in the egg, it can be-

- i. Holoblastic
- ii. Meroblastic

1. Holoblastic:

Four major holoblastic cleavage types can be observed in general-radial, spiral, bilateral, and rotational.

Planes of Cleavage:

During early cleavage, distinct geometrical relationships exist between the blastomeres, i.e., each plane of cell-division bears a definite relationship with each other.

The planes of division are:

a. Meridional plane of cleavage:

When a furrow bisects both the poles of the egg passing through the median axis or centre of egg it is called meridional plane of cleavage. The median axis runs between the centre of animal pole and vegetal pole.

b. Vertical plane of cleavage:

When a furrow passes in any direction (does not pass through the median axis) from the animal pole towards the opposite pole.

c. Equatorial plane of cleavage:

This type of cleavage plane divides the egg halfway between the animal and vegetal poles and the line of division runs at right angle to the median axis.

d. Latitudinal plane of cleavage:

This is almost similar to the equatorial plane of cleavage, but the furrow runs through the cytoplasm on either side of the equatorial plane.

Types of Cleavage:

Considerable amount of re-organisation occurs during the period of cleavage and the types of cleavage depend largely upon the cytoplasmic contents.

Different types of cleavage encountered in different eggs are catalogued below:

a. Holoblastic(total cleavage):

When the cleavage furrows divide the entire egg.

It may be:

Equal:

When the cleavage furrow cuts the egg into two equal cells. It may be radially symmetrical, bilaterally, symmetrical, spirally symmetrical or irregular.

- a. **Radial cleavage:-** Holoblastic cleavage that is typical of deuterostomes and that is characterized by arrangement of the blastomeres of each upper tier directly over those of the next lower tier resulting in radial symmetry around the pole to pole axis of the embryo.
- b. **Spiral cleavage:-** Holoblastic cleavage that is typical of protostomes and that is characterized by arrangement of the blastomeres of each upper tier over the cell junctions of the next lower tier so that the blastomeres spiral around the pole to pole axis of the embryo.
- c. **Bilateral cleavage:-** In this type of cleavage, blastomeres produced by the first cleavage divided in the same pattern and this same pattern of the division followed by each blastomere pair produces by cleavage and thus blastomere produces the mirror image of each other.
- d. **Rotational cleavage:-** Rotational cleavage involves a normal first division along the meridional axis, giving rise to two daughter cells. The way in which this cleavage differs is that one of the daughter cells divides meridionally, whilst the other divides equatorially

Unequal:

When the resultant blastomeres become unequal in size.eg. Mesolecithal egg in frogs.

2. Meroblastic cleavage: When segmentation takes place only in a small portion of the egg resulting in the formation of blastoderm, it is called meroblastic cleavage. Usually the blastoderm is present in the animal pole and the vegetal pole becomes laden with yolk which remains in an uncleaved state, i.e., the plane of division does not reach the periphery of blastoderm or blastodisc.

A. **Telolecithal:-** The yolk is dense and concentrated at one end of the egg, we call these telolecithal egg ('telos' means 'end'-think of the two poles on Earth as being the different 'ends'). There are two different patterns of meroblastic cleavage for telolecithal cells.

1. **Bilateral cleavage :-** In this type of cleavage, blastomeres produced by the first cleavage are divided in the same pattern and followed by cleavage and thus blastomere produces the mirror image of each other.

2. **Discoidal cleavage :-** Meroblastic cleavage in which a disk of cells is produced at the animal pole of the Zygote(as in bird eggs).

B. Centrolecithal :- Centrolecithal (Greek Kentron =Center of a circle, lekithos =yolk) describes the placement of the yolk in the centre of the cytoplasm of ova. During cytokinesis, centrolecithal zygotes undergo meroblastic cleavage, where the cleavage plane extends only to the accumulated yolk and is superficial.

Superficial cleavage:- cleavage occurs superficial due to center located yolk. In this type of cleavage, karyokinesis occurs without cytokinesis .In this type of cleavage pole cells are formed at the posterior pole. The pole cell becomes primordial germ cells and gives rise to gonads.

Determinate

Determinate cleavage (also called mosaic cleavage) is in most protostomes. It results in the developmental fate of the cells being set early in the embryo development. Each blastomere produced by early embryonic cleavage does not have the capacity to develop into a complete embryo.

Indeterminate

A cell can only be indeterminate (also called regulative) if it has a complete set of undisturbed animal/vegetal cytoarchitectural features. It is characteristic of deuterostomes – when the original cell in a deuterostome embryo divides, the two resulting cells can be separated, and each one can individually develop into a whole organism.

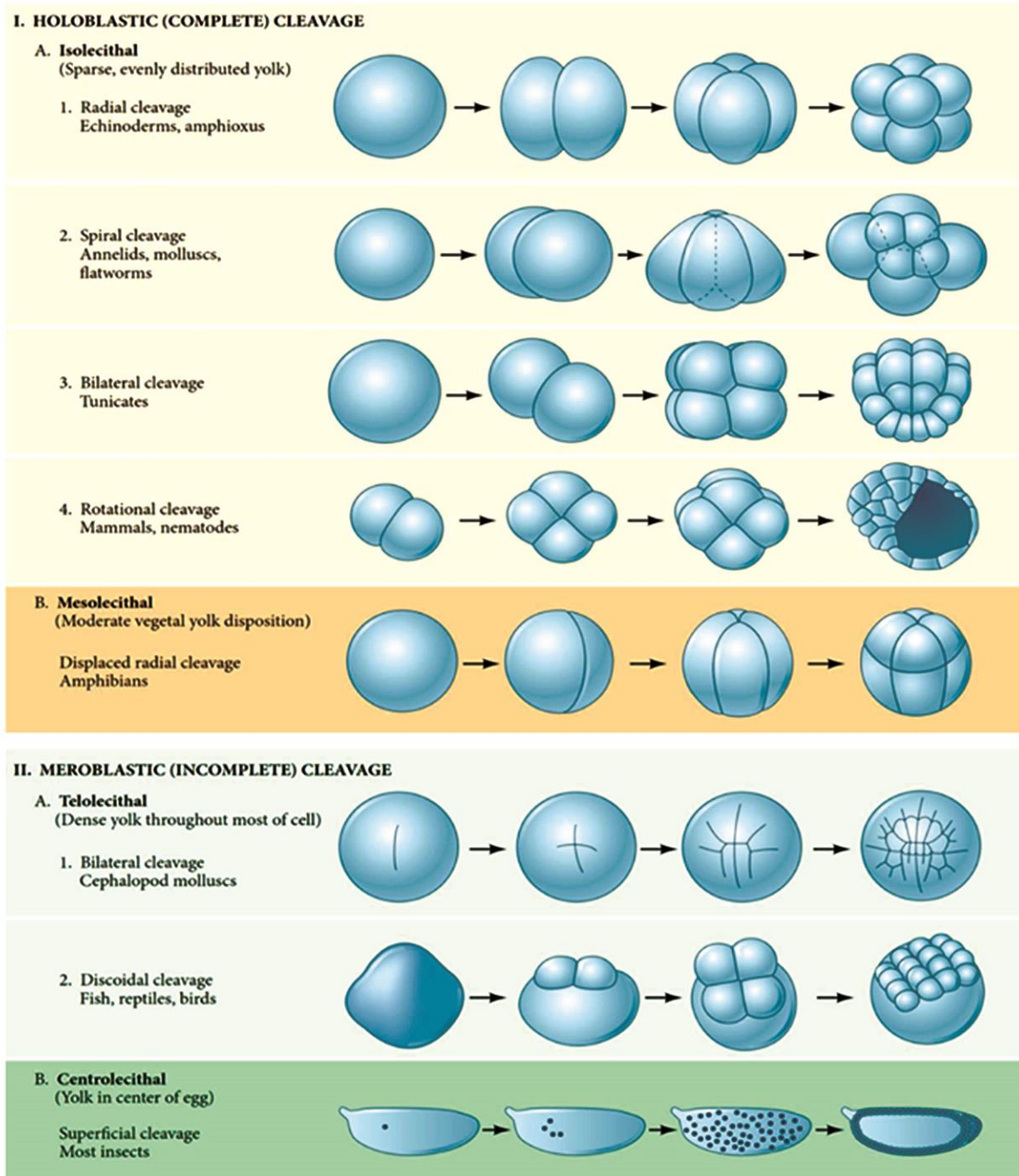


Fig- Types of Cleavage