

Cleavage

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Cleavage

- Within a few hours of fertilization, the fertilised egg undergoes a series of repeated mitotic cell divisions, which occur in rapid succession to produce an increase in the number of cells without any addition to its volume.
- This phase of repeated divisions of the egg is known as- **CLEAVAGE OR SEGMENTATION**.
- The cleavage was first observed by **Swammerdam** in 1738 in frog's egg.
- In 1780, **Spallanzani** described the first two cleavage planes of toad's eggs.

Various patterns of Cleavage-

The repeated cleavage furrows produce a number of blastomeres which exhibit a specific pattern of arrangement. The following types of cleavage patterns have been studied in different mammals on various basis :-

- 1. On The Basis Of cleavage furrow.**
- 2. On The basis of fate of germ layers**
- 3. On The Basis Of arrangement of the cells**

A. On The Basis of Cleavage furrow-

❑ Holoblastic equal cleavage-

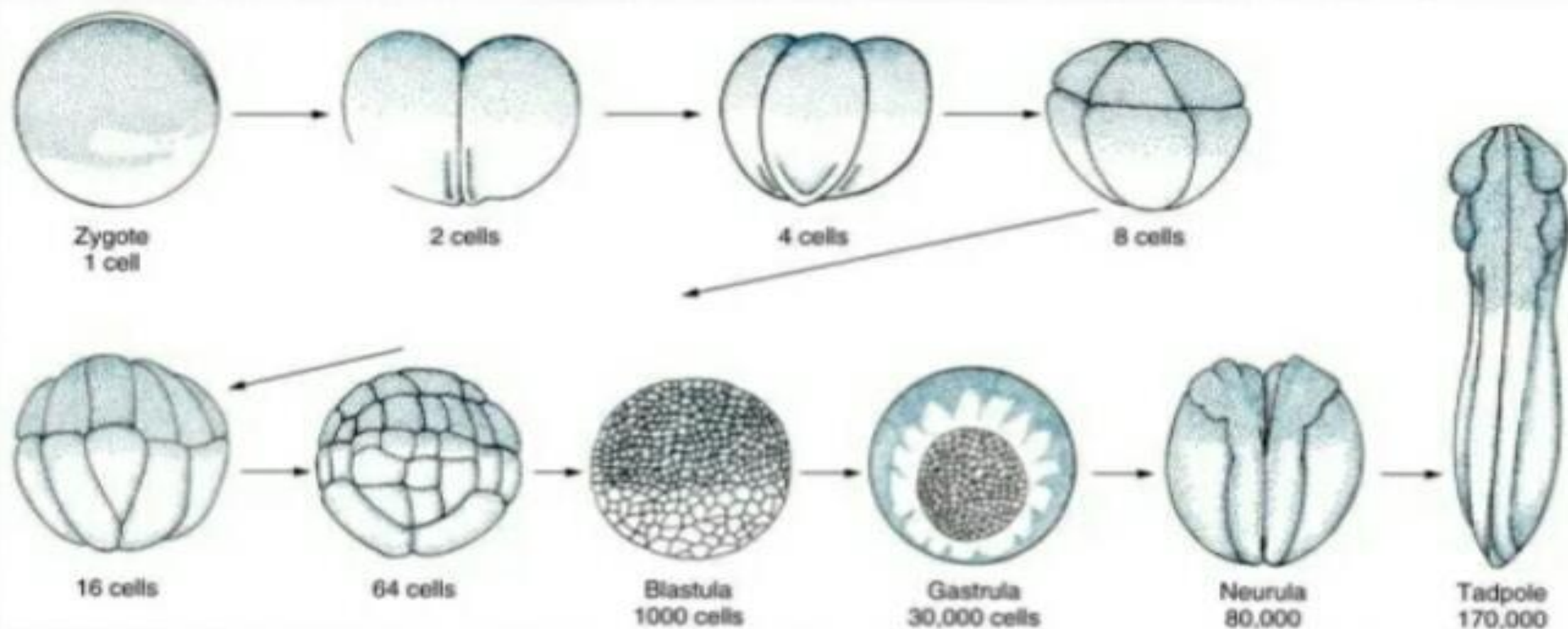
In this type of cleavage, the cleavage furrow extends completely through the entire length of the egg and bisects it into equal blastomeres. It occurs in microlecithal eggs.

❑ Holoblastic unequal cleavage-

In such type of cleavage the yolk is distributed along vegetal animal axis. The yolk is sparse in the animal pole and gradually increases towards the vegetal pole. The first and second furrow are laid down similar to those as in holoblastic equal cleavage. Third furrow is not equatorial but towards the animal pole producing 4 small cells in animal and 4 large cells in Vegetal hemisphere called **macromeres and megameres**.

This type of pattern is seen in lower fishes and amphibians.

Holoblastic cleavage



❑ **Meroblastic cleavage or Discoidal cleavage-**

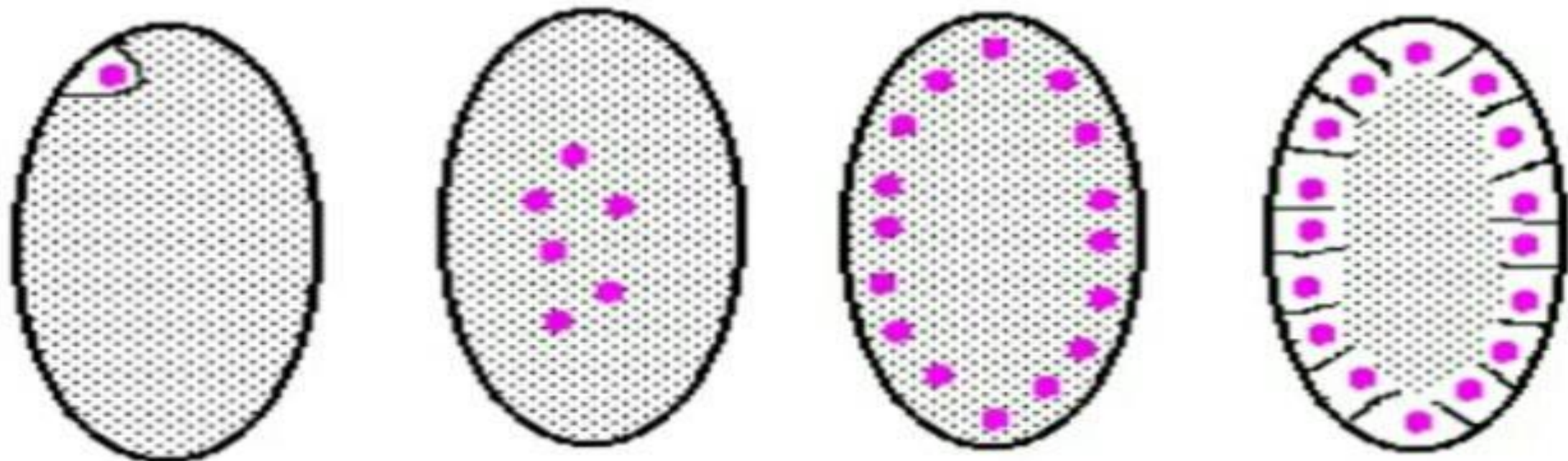
It occurs in megalecithal or heavily telolecithal eggs, which have an enormous amount of yolk. The active portion of the egg is confined to a small cytoplasmic region at the animal pole called the germinal disc or blastodisc. The cleavage furrows are restricted to the germinal disc, the yolk remains uncleaved.

The early blastomeres are incomplete and are continuous with the underlying yolk.

Examples- abairds, reptiles, bony fishes and monotreme eggs, elasmobranchs.

Meroblastic cleavage

Centrolecithal egg with Meroblastic Cleavage



- **Superficial cleavage-**

This cleavage occurs in centrolecithal eggs. Here, the early divisions occur in the surface layer of the egg and cleavage furrows do not extend into the central yolk. In centrolecithal eggs, the zygote nucleus lies in the centre of the egg. It divides repeatedly without the div of the egg cytoplasm. As a result, a large number of nuclei are formed. These remain embedded in the undivided superficial layer of cytoplasm. The cytoplasm divides by furrow laid down from the surface towards inner side and separates into a large number of cells arranged around central yolk.

Superficial cleavage

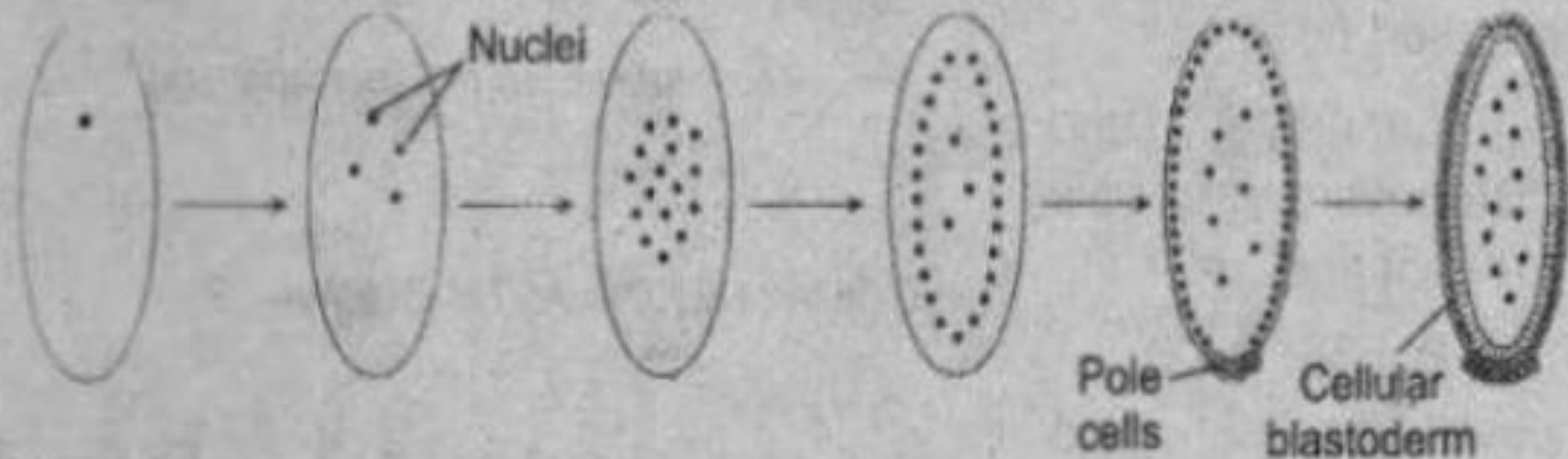


Figure 8-4

Superficial cleavage in an insect (*Drosophila*) embryo. The zygote nucleus at first divides repeatedly in the yolk-rich endoplasm by mitosis without cytokinesis. After several rounds of mitosis most nuclei migrate to the surface where they are separated by cytokinesis into separate cells. Some nuclei migrate to the posterior pole to form the primordial germ cells, called pole cells. Several nuclei remain in the endoplasm where they will regulate breakdown of yolk products. The cellular blastoderm stage corresponds to the blastula stage of other embryo.

B. On The Basis Of Fate Of Germ Layers-

1. Indeterminate cleavage –

In indeterminate cleavage, the fate of blastomeres is not so rigidly sealed, but the blastomeres exhibit plasticity. For examples, each of the 2 blastomeres of a zygote, if separated after the first cleavage, can produce one complete embryo.

This type of cleavage, in which future of blastomeres is not predetermined, is known as Indeterminate cleavage.

Examples – vertebrates.

2. Determinate Cleavage-

In some animals (Ascaris), the blastomeres have a predetermined future, i.e definite blastomeres are determined to give rise to specific parts of the embryo. This type of cleavage is known as Determinate cleavage.

As a result of determinate cleavage, a mosaic type of blastula is formed. This type of development is called mosaic development.

Example- Ascaris egg.

C. On The basis Of arrangement of cells-

1. Radial cleavage-

In radial cleavage, the successive cleavage furrow cut straight through the egg, at right angles to one another so that the resultant blastomeres appear to be arranged radially.

All those eggs which have holoblastic cleavage, exhibit radial cleavage.

Examples- Synepta eggs.

Radial cleavage



2. Spiral cleavage-

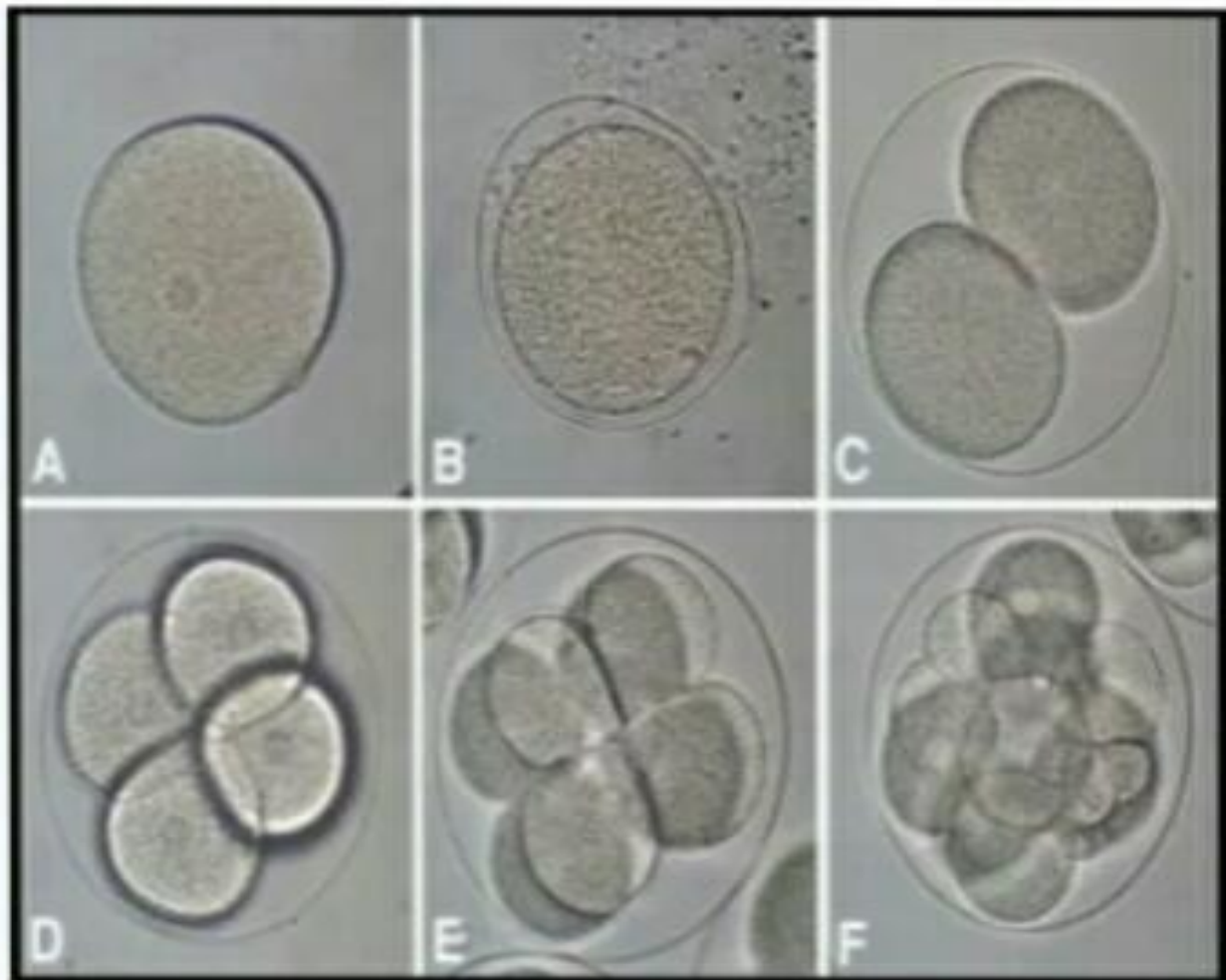
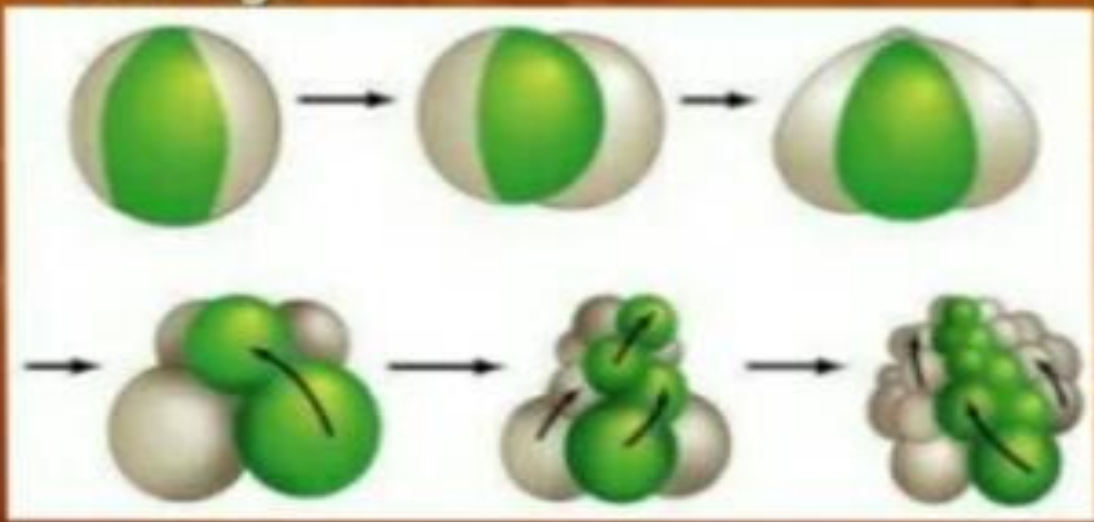
It is a modification of the radial cleavage . In this, the mitotic spindles of the third clv in the four blastomeres are laid down obliquely and are arranged in a sort of spiral so that the 4 blastomeres of upper tier do not lie over the corresponding blastomeres of lower tier but between them. This type of cleavage is known as **spiral cleavage**. The turn of spiral may be in a clockwise or counter clockwise direction.

Examples- Annelids, Molluscs.

Spiral cleavage

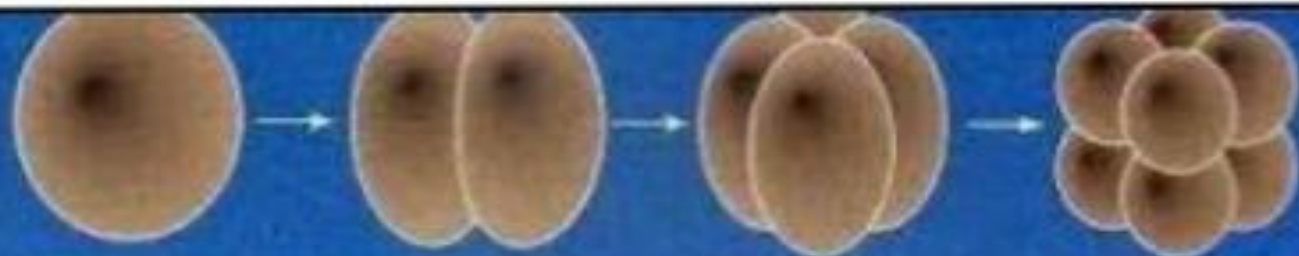
Cleavage

- Divide at oblique angles so that they pile up in a pattern called **spiral cleavage**



(Sparse, evenly distributed yolk)

1. Radial
Echinoderms, amphioxus



2. Spiral
Annelids, molluscs,
flatworms



3. Bilateral
Tunicates



4. Rotational
Mammals, nematodes





THANK YOU!!!!!!