CLEAVAGE AND ITS PATTERNS

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Cleavage

- With in few hours of fertilization, the fertilised egg undergoes a series of repeated mitotic cell divisions, which occur in rapid succession to produce anincrease 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 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 -

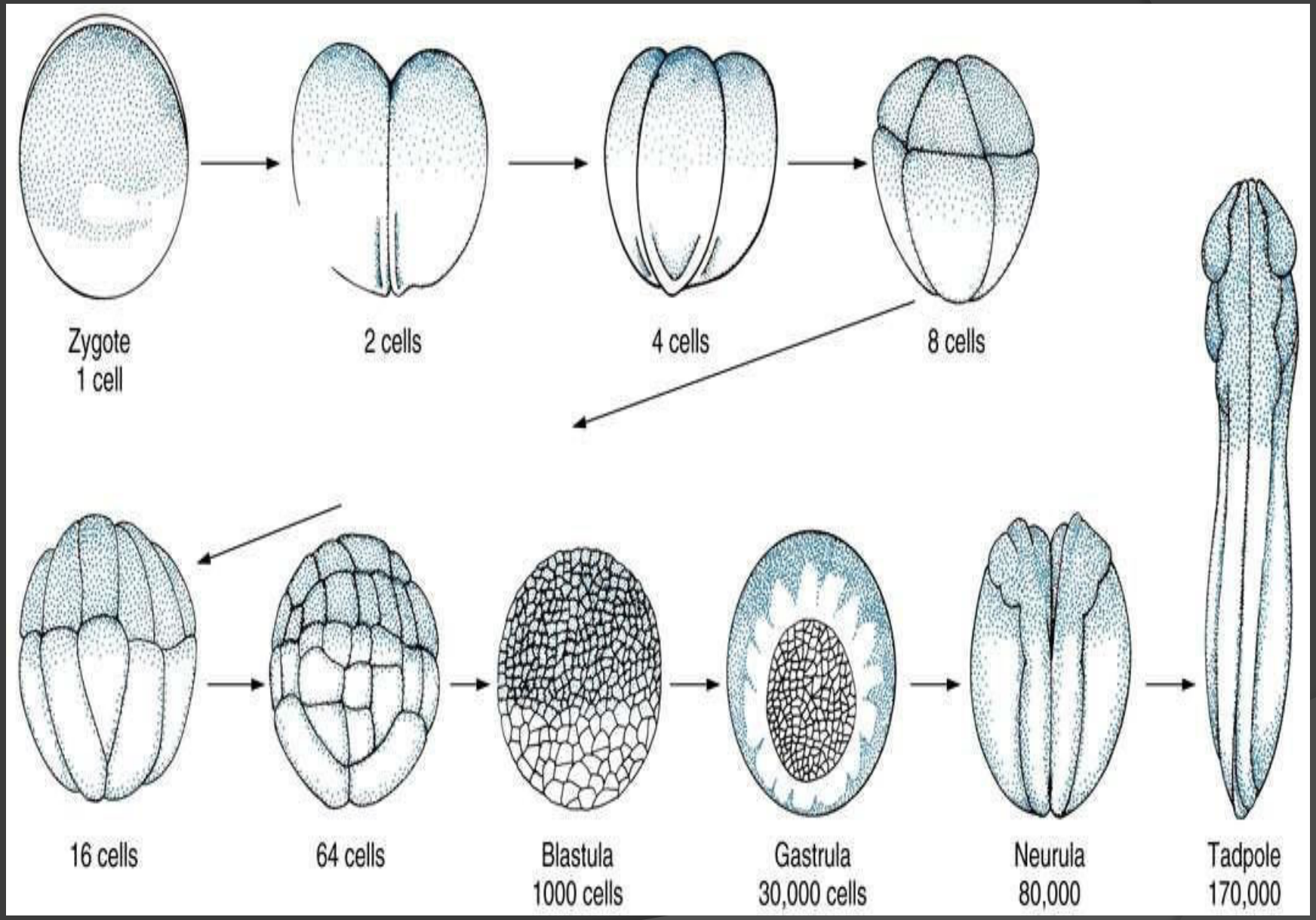
- **On The Basis Of cleavage furrow.**
- **On The basis of fate of germ layers.**
- **On The Basis Of arrangement of the cells.**

On The Basis Of cleavage furrow

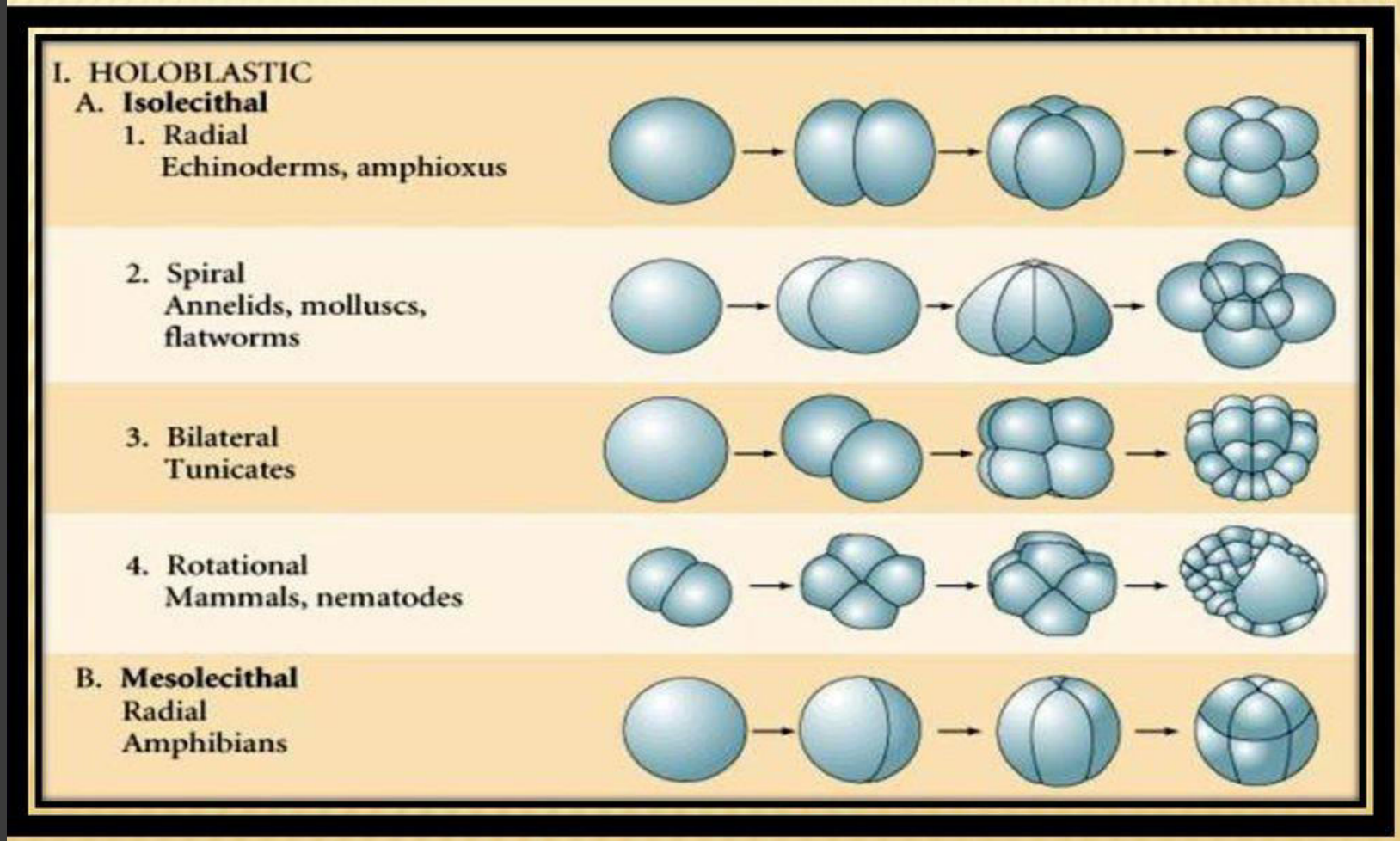
- **Holoblastic cleavage-**

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.


Zygote
1 cell
2 cells
4 cells
8 cells
16 cells
64 cells
Blastula
1000 cells
Gastrula
30,000 cells
Neurula
80,000
Tadpole
170,000

TYPES OF HOLOBLASTIC CLEAVAGE:



- **Meroblastic cleavage -**

It occurs in megalecithal or heavily telolecithal eggs, which have anormous 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.

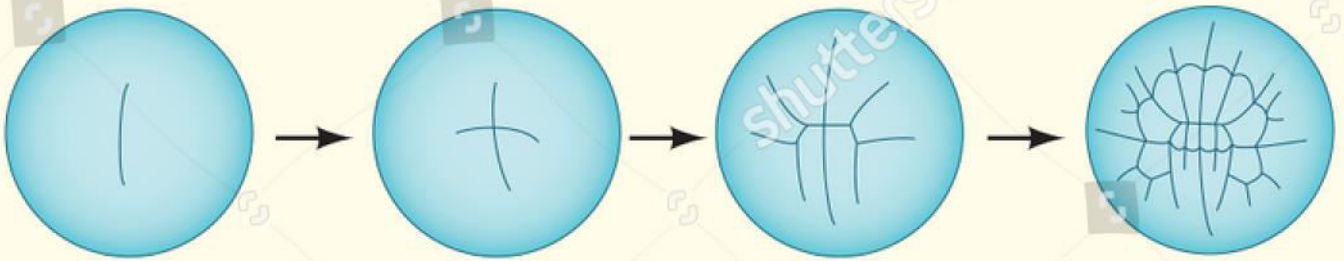
The early blastomeres are incomplete and are continuous with the underlying yolk.

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

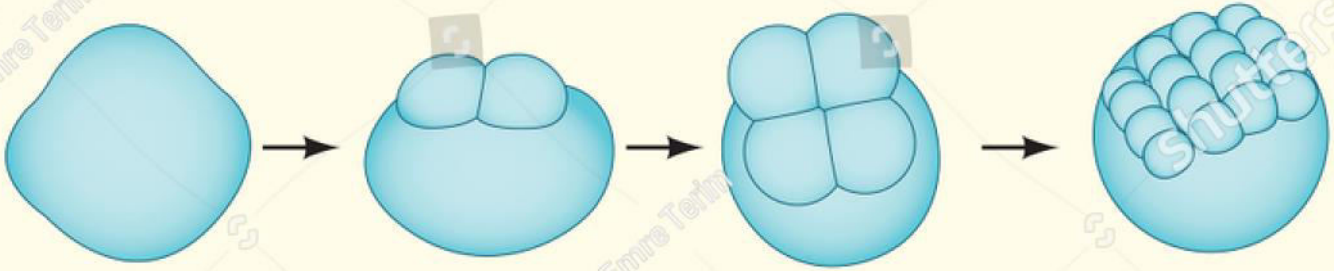
MEROBLASTIC (INCOMPLETE) CLEAVAGE

Telolecithal

1. Bilateral cleavage



2. Discoidal 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 repeatdly without the div of the egg cytoplasm. As as 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 arranges around central yolk.

SUPERFICIAL CLEAVAGE

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 knows 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.

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.

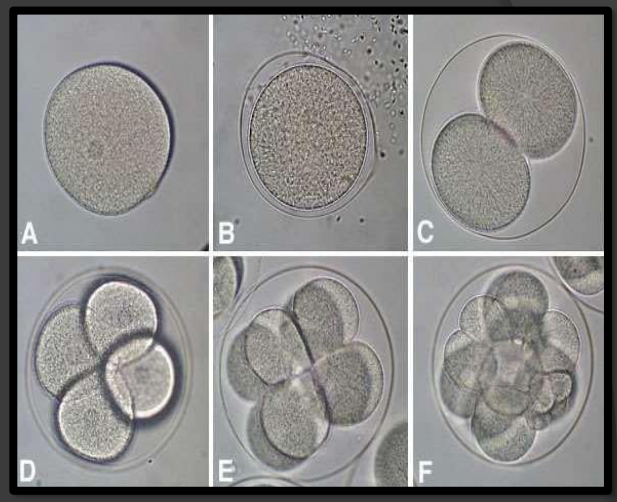
All those eggs which have holoblastic cleavage, exhibit radial cleavage.

Examples- Synepta eggs.

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 ina clockwise or counter clockwise direction.

Examples- Annelids, Molluscs.



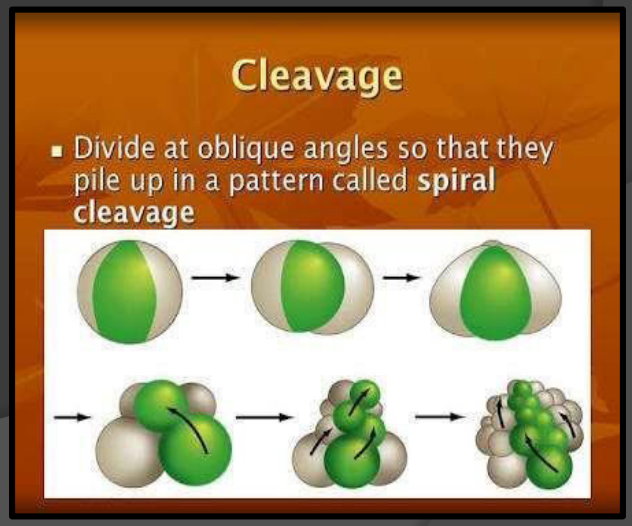
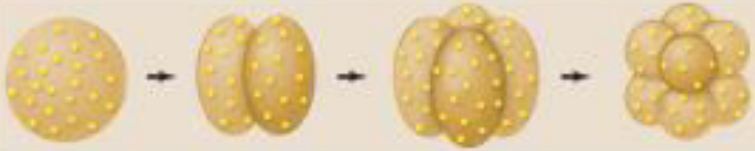
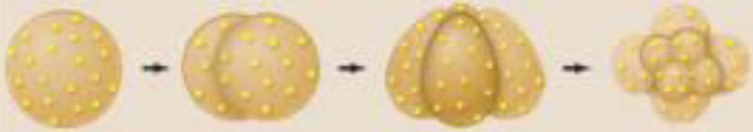


TABLE 54.2 The Major Cleavage Patterns of Animal Embryos

HOLOBLASTIC (COMPLETE) CLEAVAGE	
Isolecithal (Sparse, evenly distributed yolk)	
Radial cleavage Echinoderms	
Spiral cleavage Annelids Mollusks Flatworms	
Rotational cleavage Mammals Nematodes	
Mesolecithal (Moderate vegetal yolk disposition)	
Displaced radial cleavage Amphibians	
MEROBLASTIC (INCOMPLETE) CLEAVAGE	
Telolecithal (Dense yolk throughout most of cell)	
Discoidal cleavage Fish Reptiles Birds	
Centrolecithal (Yolk in center of egg)	
Syncytial cleavage Most insects	

THANK YOU