# TITLE---CLEVAGE AND SEGMENTATION

FOR CLASS---BSc SEMESTER 4

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## CLEVAGE AND SEGMENTATION

Zygote divides repeatedly to form more cells. As the division proceeds number of cells increases but size of the cells become smaller and smaller as the total volume of the embryo remains constant.

The progressive subdivisions of the zygote by mitosis into increasing number of cells of progessively decreasing size is called clevage or segmentation or blastulation. The mass of the cells formed at the end of clevage is called morula.

### Features of clevage

1-All clevage divisions are mitotic.

2-During clevage number of cells increases but

there size decreases.Thus clevage begins with one large cell and ends with large number of small cells.

3-Size of nucleus do not decrease. Thus nucleocytoplasmic ratio increases during clevage.

4-The pace or rhythm of clevage is determined by cytoplasm rather than nucleus.

5-During clevage metabolic activities take place at a tremendous rate. Oxygen consumption increases greatly.

6-DNA synthesis increases greatly.

**Pattern of clevage**

**1-Radial Clevage--P**lane of the division in the cleaving zygote is along the radii. Clevage furrows are laid perpendicular to one another and resultant blastomeres are equal in size. Example Echinodermata, Porifera

**2-Bilateral Clevage---**Clevage furrows laid in such a manner that blastomeres are arranged in a bilateral symetry. Spindles are oblique. All

blastomeres are not of same size. Example Ctenophora, Tunicata, Cephalochordata

**3-Spiral Clevage**----Part of the cells rotate around the axis of egg. Clevage plane is oblique in relation to the axis of egg and equator of the egg. Blastomeres arranged in regular tiers. Example Annelida and Mollusca.

**4-Determinate Clevage**---Clevage furrows are precise and definite blastomeres form specific part of embryo. Example Ascaris

## FACTORS AFFECTING RATE OF CLEVAGE

Temperature, light, amount and distribution of yolk

## RULES GOVERNING CLEVAGE

**1-Sach's law**--cells divide at right angle to the previous plane of division

**2-Hertwig's law**--The division is at right angle to the long axis of the mitotic spindle

**3-Pfluger's law**--The mitotic spindle elongates in the direction of the least resistance.

**4-Balfour's law**--The rate of clevage is inversally proportional to the mass of yolk

## TYPES OF CLEVAGE

Types of Clevage based on amount of yolk

**1-HOLOBLASTIC CLEVAGE**---Clevage is total and divide the zygote completly. If the clevage furrow divide the egg completely into equal blastomeres it is called holoblastic equal clevage for example Amphioxus and if the clevage furrow results in unequal blastomeres it is called holoblastic unequal clevage for example Pisces and Amphibians.

**2-MEROBLASTIC CLEVAGE**--Division is incomplete, not divide the zygote completely into two. Restricted to germinal disc only. found in macrolecithal eggs. Active cytoplasm(germial disc) is confined to a small area at animal pole due to enormous amont of yolk.

**A-DISCOIDAL CLEVAGE**--Active cytoplasm lies in a small area at animal pole . Clevage divides the active cytoplasm only eg Reptiles, Birds

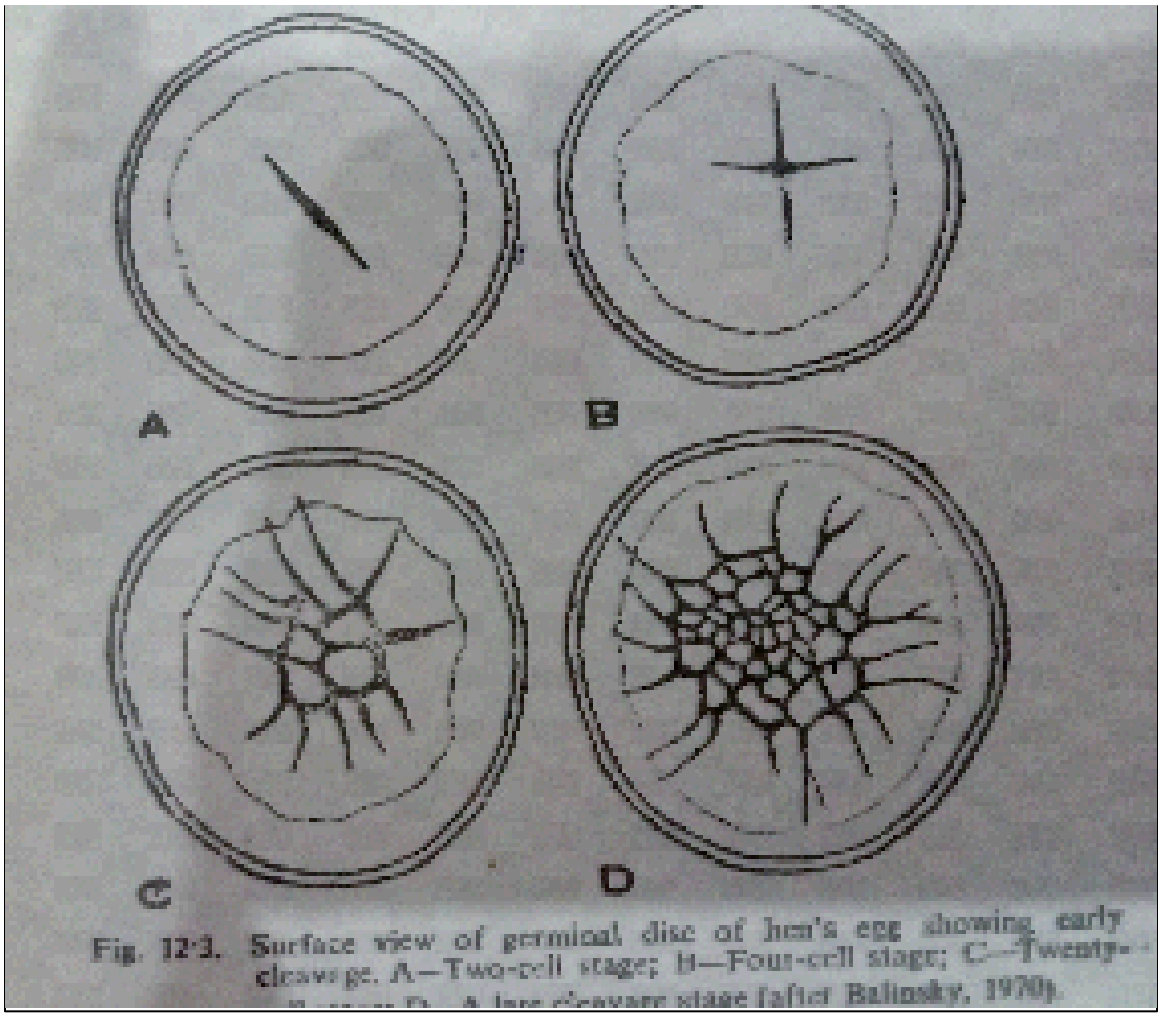



Fig. 12·3. Surface view of germinal disc of hen's egg showing early cleavage. A—Two-cell stage; B—Four-cell stage; C—Twenty-

**B-SUPERFICIAL CLEVAGE**--The clevage divides the periferal cytoplasm as the yolk is present in the center of the zygote eg insects.

**Morula-**-As a result of repeated clevage solid ball of blastomeres are formed called morula.

## Blastula and Blastulation

The blastomers of morula get arranged in a single layer at perifery and a cavity is formed in

the center called blastocoel. Such a structure with blastocoel and single layer of blastomeres is called blastula and the formation of blastula from the morula is called blastulation. In isolecithal eggs blastocoel is central while in mesolecithal eggs blastocoel is shifted towards animal pole. In Macrolecithal eggs clevage occur in germinal disc and the blastocoel is found in area pellucida.

## Types of Blastula

**STEREOBLASTULLA**--Blastula is mass of cells, no cavity.Example Annelida, Mollusca, Nemertians

**COELOBLASTULLA**--Blastula has large central cavity called blastocoel. Blastoderm arranged in single layer . Example Amphioxus, Echinodermata

**DISCOBLASTULLA**--Active cytoplasm lies in form of a layer on the yolk. Blastula formed at animal pole as multilayered flat disc separated from underlying yolk by subgerminal cavity. Example Pisces, Reptiles, Birds

**BLASTOCYST--**In mammal, during clevage a small cavity appears inside the dividing cells called blastocoel which increase in size progressively. The blastomeres differenciates into trophoblast cells surrounding the blastocoel and an inner cell mass spread inside the cavity as flat disc. This stage is called blastocyst. At blastocyst stage embryo got implanted to uterus.

## FATE MAPS

A chart showing the fate of each part of an early embryo in a particular blastulla is called fate map.

## CONSTRUCTION OF FATE MAPS

## NATURAL MARKINGS

In some animals such as Ascidians the cytoplasm of the fertilized egg has natural colour difference in various region and on the basis of this difference differnet regions of the fertilized egg is constructed .

Example- In Styela, there is four regions.

1-Upper hemisphere of light protoplasm

(prospective ectoderm),

2-Yellow crecent postereoventral (prospective mesoderm),

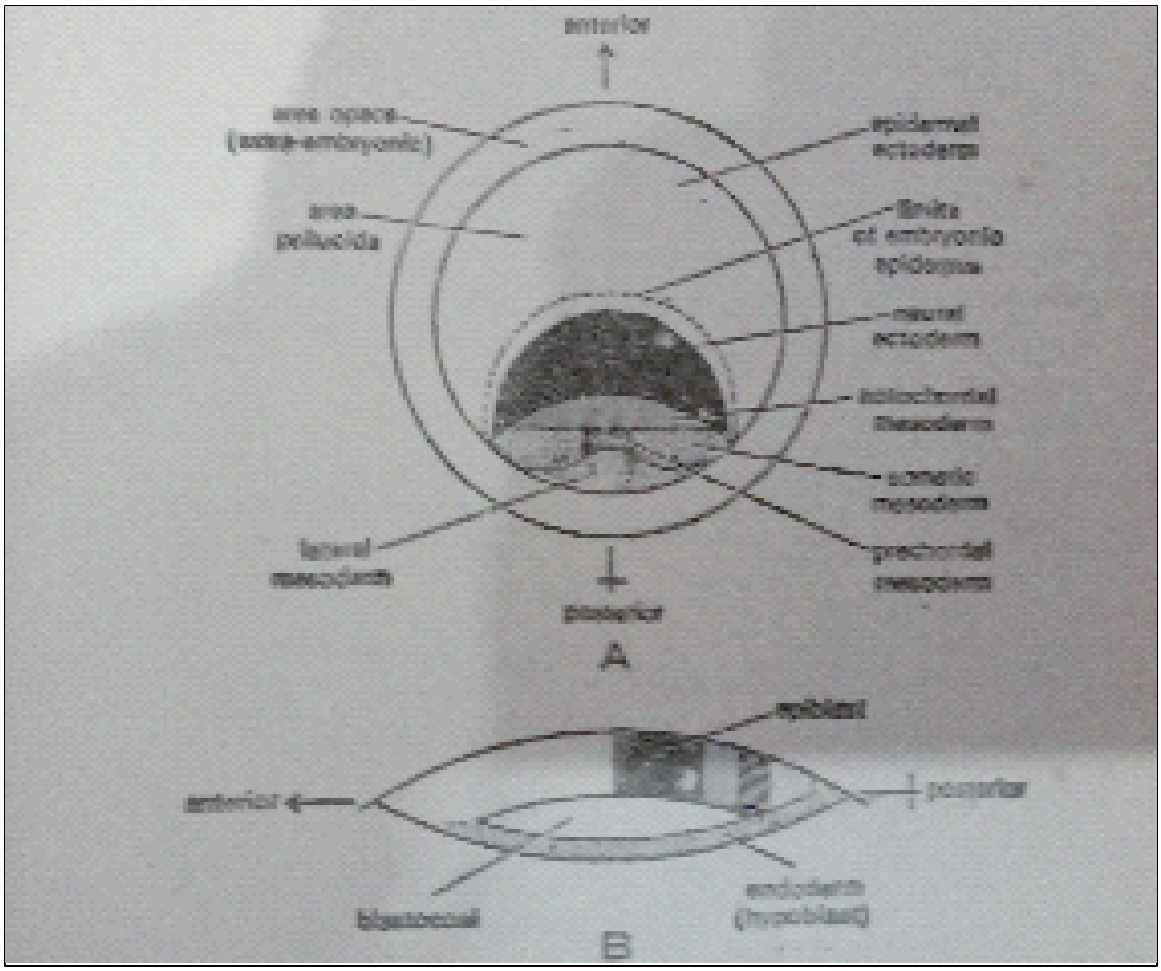
3-Grey crecent of antereodorsal region and

4-Dark grey yolky substance of vegetative area (prospective endoderm) .

## ARTIFICIAL MARKING

## VITAL STAIN MARKING

W Vogt 1925 used vital stains for constructing fate map. In amphibians, a small piece of agar or cellophane is stained with vital stain (Nile blue sulphate, Neutral red, Janus green) and pressed against a chosen area of frog blastula. The stain diffuses from agar or cellophane to the blastomeres. By so marking several areas simultaneously and observing continuously movements of cells in gastrulation may be marked.




## CARBON PARTICLE MARKING

Spratt 1946 devised this. In this method, tiny carbon particles applied to the surface of embryo which get attached to the surface of cells and can be used as marker to follow movement of cells and construction of fate map

## RADIOACTIVE LABELLING OF BLASTOMERS