Quadrant II – Transcript and related materials

Programme : **Bachelor of Science (Third Year)**

Subject : **Zoology**

Paper Code : **ZOC 108**

Paper Title : **Developmental Biology**

Unit : **1- Introduction**

Module Name : **Fate maps and cell lineage Part - II**

Name of the Presenter : **Ms. Sheena Paul.**

Notes

Construction of fate maps using artificial markings:
All animal embryos do not show natural markings. In such cases, artificial markers are used to construct fate maps. Various types of artificial marking methods can be used in fate map construction.

a) Vital dye staining

b) Carbon particle marking

c) Radio isotope markers

a) Vital dye staining method: this method was devised by W. Vogt in 1925. Vital dyes, which stain the embryo without causing injury are used in this technique. e.g. Nile blue sulphate, Janus green, Bismarck brown, Neutral red etc. This process involves loading the vital dye onto stain carriers such as agar agar or cellophane. A small piece of the stain loaded carrier is placed on the surface of the embryo in the required position for a short duration. Care should be taken not to injure the vitelline membrane. The vital stain diffuses from the carrier, through the semi permeable vitelline membrane, into the blastomere which will retain the dye for a long time. All the blastomeres and tissues developing from that blastomere will retain the colour of the dye thereby indicating the fate of that blastomere. Different areas of the blastula can be marked simultaneously by different vital dyes and the fate of the blastomeres can be studied.

b) Carbon particle marking method: This method was devised by Spratt in 1946. In this method, the surface of the embryo is marked with insoluble carbon particles which stick to the surface of the blastomeres and their movements can be studied over a period of time. The fate maps of the entire embryo can be constructed by a series of these experiments.

c) Radioactive isotope marking method: Radioactive substances such as tritiated thymidine, Carbon-14, Phosphorus-22 etc. are used as markers to track the presumptive organ forming areas. This technique involves labelling of

blastomeres with radioactive markers and subsequently fate maps can be constructed.

Fate map of chick embryo:

In chick embryo, the blastoderm is bilaminar consisting of epiblast and hypoblast. Both layers contribute to organ formation. Fate map of the chick blastula is made for both layers using vital stains and carbon particle methods.

Epiblast may be differentiated into following layers.

1) Anterior half of epiblast forms a) presumptive epidermal ectoderm forming skin and epidermis b) presumptive neural plate region which forms the central nervous system and sense organs.

2) Presumptive notochord region in the mid dorsal line which forms the notochord.

3) Presumptive somite region just below the notochordal region which develops into the musculature.

4) Posterior half of the epiblast forms the ventrolateral mesoderm which lines the body cavity.

5) Presumptive extra embryonic membrane area which gives rise to the extra embryonic membranes.

6) Hypoblast gives rise to endoderm and partly to the notochord.

Fate maps are of great use in understanding the mechanism of gastrulation and the morphogenetic movements of cells and their final positions in the tissues.

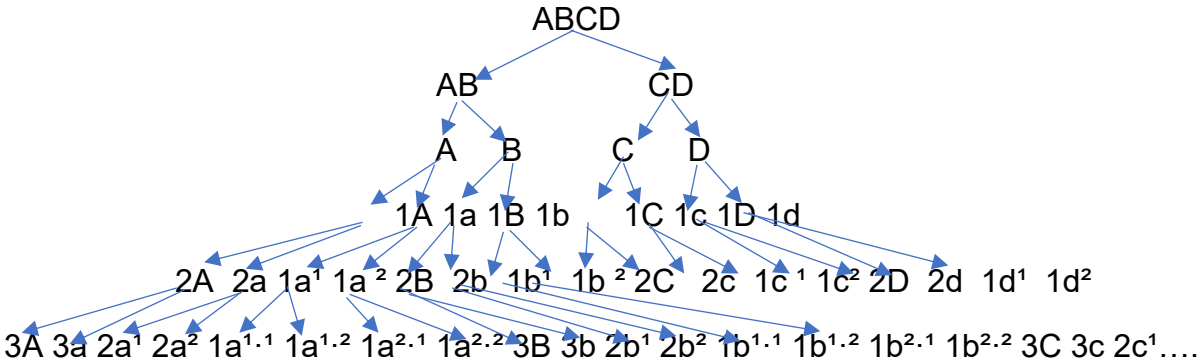
Cell lineage (cytogeny):

The observation and study of the developmental history of each blastomere is termed as cell lineage study or cytogeny.

Method of cell lineage study:

Cell lineage study can be done using vital staining techniques, natural markings and naming the blastomeres.

In cell lineage study to understand the fate of the blastomeres, it becomes necessary to name the early blastomeres and their progeny by certain names which is done by using the letters of the English alphabet and numbers.



Outcomes of cell lineage study:

Cell lineage study helps in establishing phylogenetic relationships. As a result of study of cleavage patterns and lineages of three major invertebrate phyla, it becomes clear that Platyhelminthes, Annelida and Mollusca are closely related. Both annelids and molluscs develop a trochophore larva with a common body plan indicating a close phylogenetic relationship. In both groups, the larval ectoderm arises from the first three micromere quartets while the remaining micromeres give rise to the mesoderm. The macromeres give rise to the endoderm. The ciliated bands, heart, nerve cord and other main tissues arise in a similar manner in both groups. Development in the two groups diverge from this common plan as unique structural adaptations such as shell gland in molluscs and metameric body plan in annelids.

Cell lineage studies reveal that each blastomere undergoes a specific number of divisions before it differentiates into a larval structure. The ultimate position and the division programme of each blastomere seems to be set at the early stages of embryonic development.