The Process of Gastrulation in Frog Embryos

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Illustration of the movement of the three hemispheres of cells, the animal cap (dark green) the marginal zone (lime green) and the ventral cap (yellow) during frog gastrulation. The external view column (images a.1-a.6) shows gastrulation as it occurs on the outside of the embryo. The cross-section view column (images b.1-b.6) shows the internal view of gastrulation. The cross-sections are through the middle of the embryo.

1. Early Gastrulation: Gastrulation begins in a blastula, a hollow ball of cells (images a.1 and b.1). The hollow space, blastocoel, sits mostly in the animal hemisphere as the vegetal cap cells are enlarged with yolk. The vegetal cap cells’ larger volume diminishes the cavity size in the vegetal hemisphere.

2. Early Gastrulation: The blastopore, a groove on the side of the embryo (a.2), forms by the infolding of cells in the marginal zone or invagination into the embryo. The blastopore lip closer to the animal pole (AP) is called the dorsal lip. The marginal cells migrate into the embryo because the animal pole cells are rapidly dividing and flattening out. The animal hemisphere expands or undergoes epiboly.

3. Mid-Gastrulation: As the marginal zone cells migrate into the embryo they line the inner wall of the animal cell sheet, or involute. They start close to blastopore dorsal lip and head towards the ventral side of the embryo until the marginal zone cells line the roof and inner walls of the embryo.

4. Mid-Gastrulation: The marginal zone cells line the roof and displace the blastocoel. A new cavity, the archenteron, (striped) forms between the cells lining the roof of the cell and cells which have not yet been involuted are constricted by the animal cap sheet cell. The yolk plug shrinks as the animal cells continue to expand until it has been absorbed into the embryo (image b.4). The animal cap sheet of cells continues to wrap around the external surface of the embryo.

5. Late-Gastrulation: The blastocoel has almost completely been displaced by the archenteron’s expansion. Most of the embryo is encased by the animal cell sheet. A yolk plug forms because (image a.5) vegetal and marginal cells that have not yet been involuted are constricted by the animal cap sheet cell. The yolk plug shrinks as the animal cells continue to expand until it has been absorbed into the embryo (image b.6).

6. End of Gastrulation: The blastula is now a gastrula. The marginal cells lining the internal walls of the embryo form the mesoderm (pink). The yolk plug made up of vegetal cells has been internalized and forms the endoderm (image b.6). The blastocoel has been obliterated and replaced by the archenteron, a new cavity with the walls lined by mesoderm, that will develop into the gut.

Subject

Topic

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