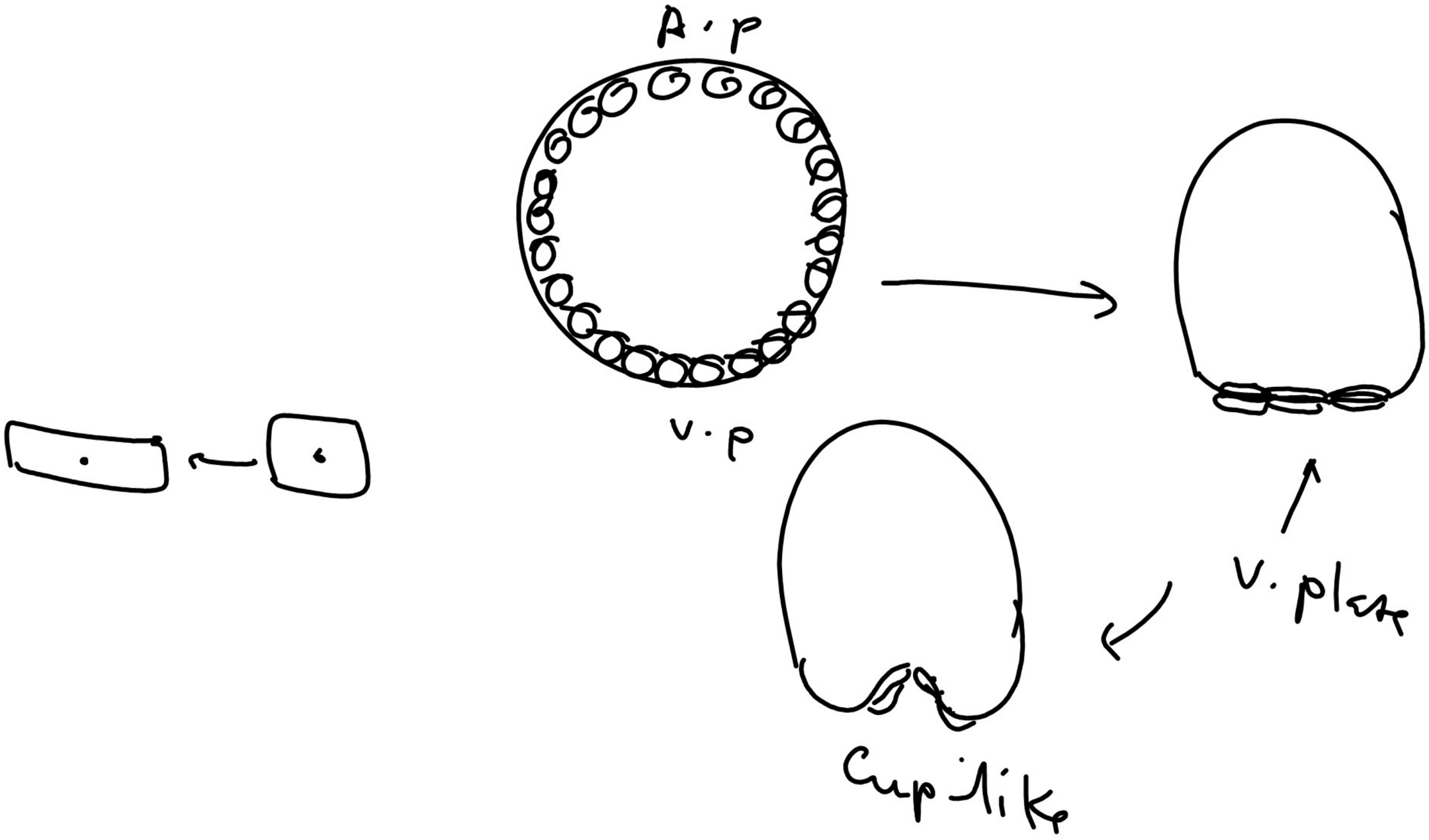
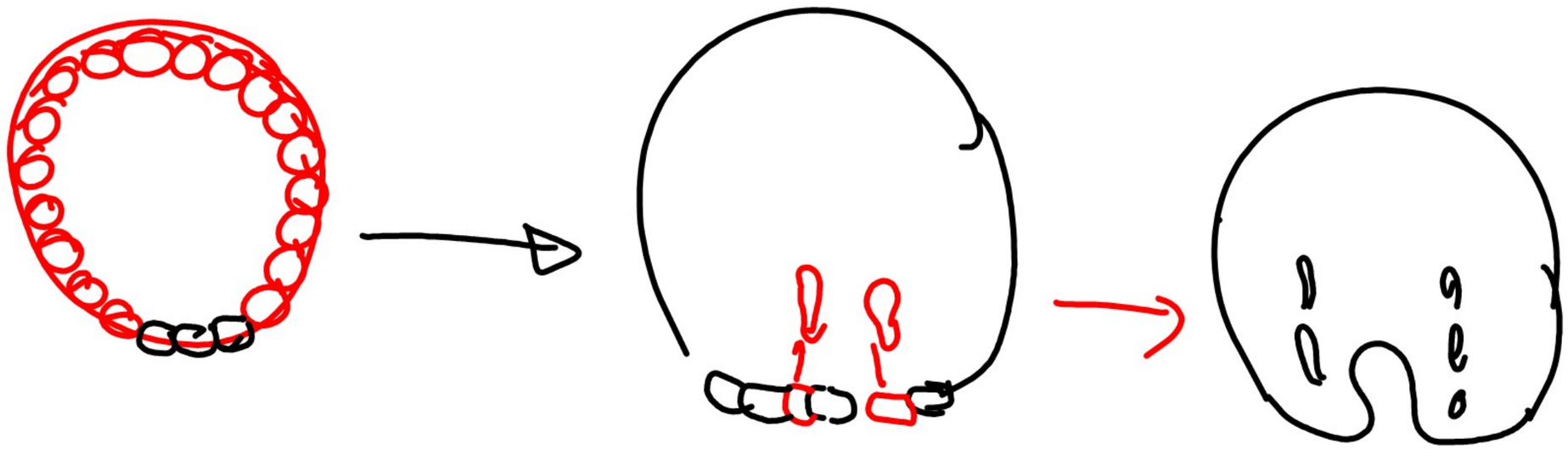
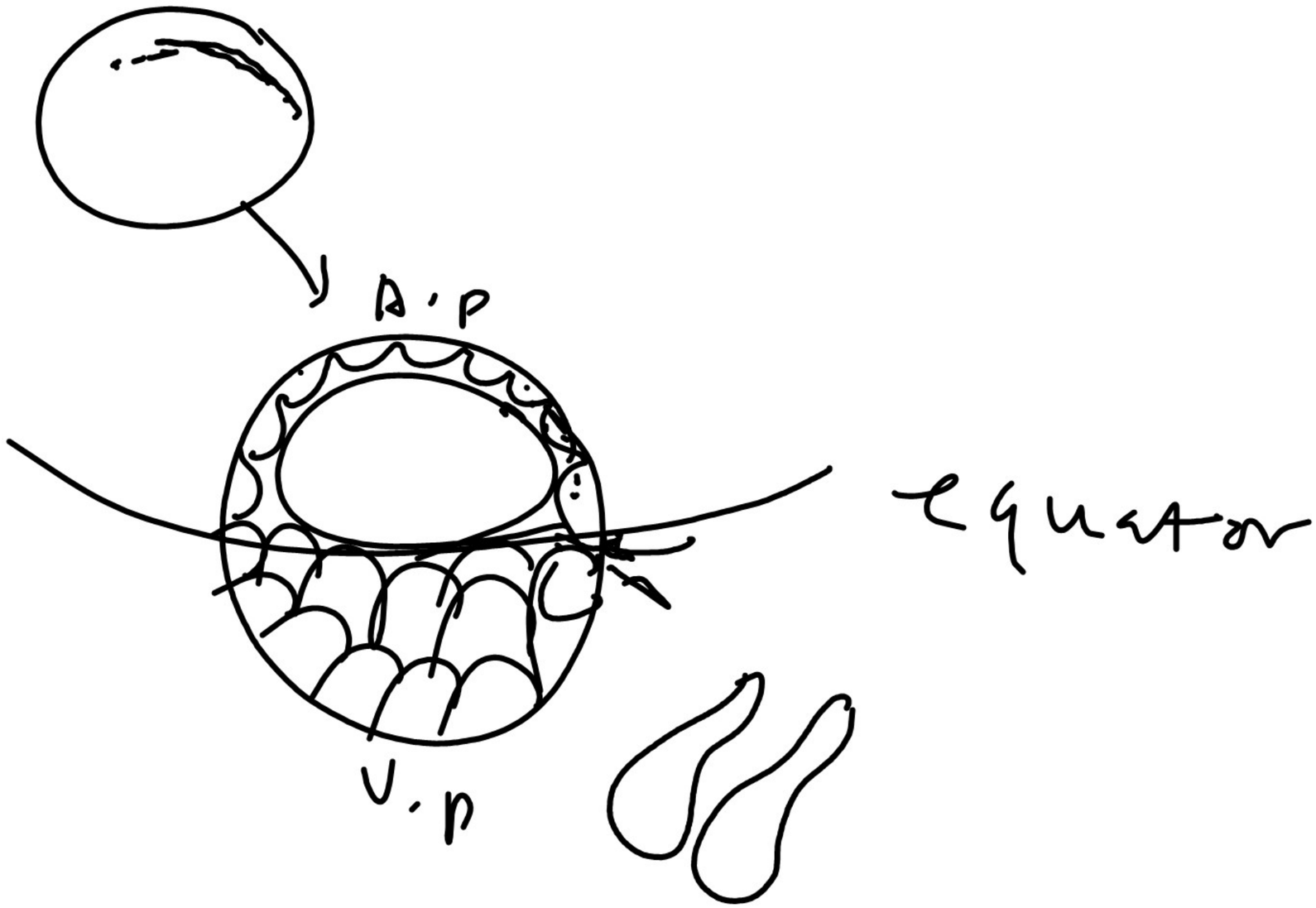
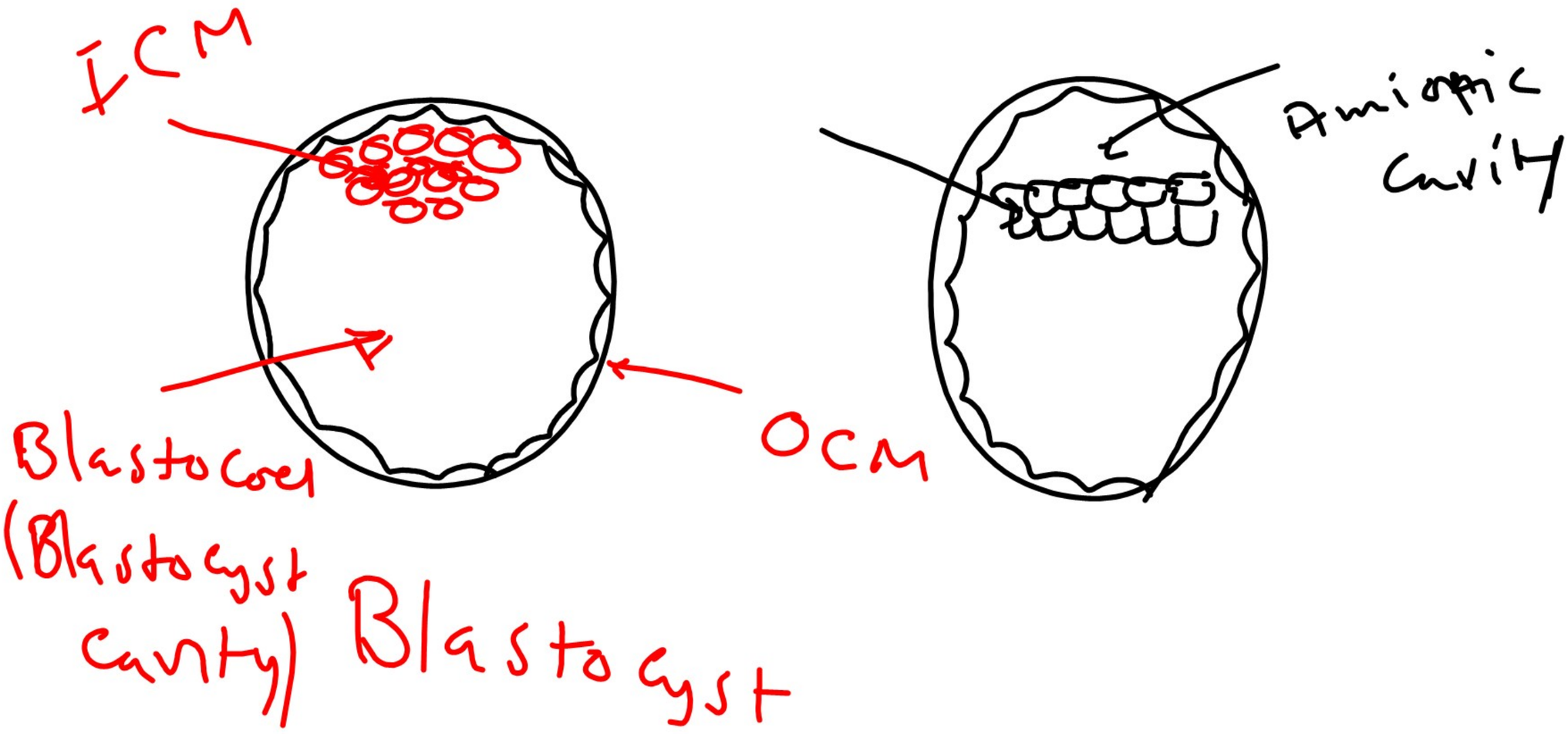

A · P
V · P
V · plast
Cup like

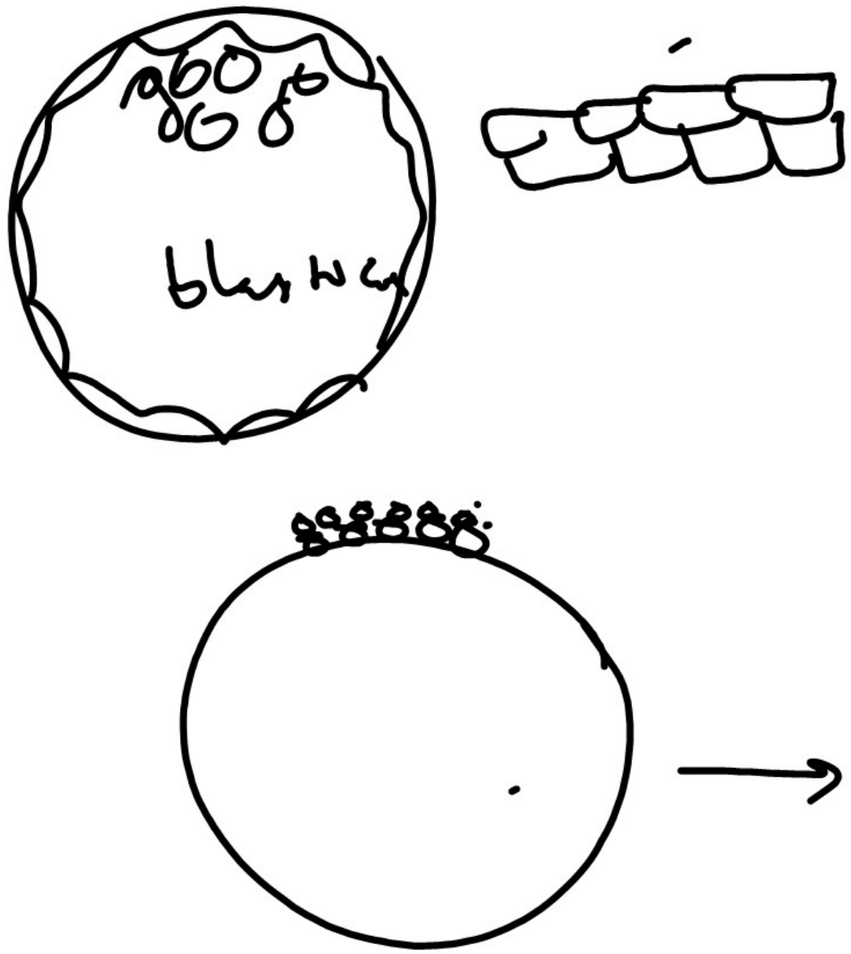


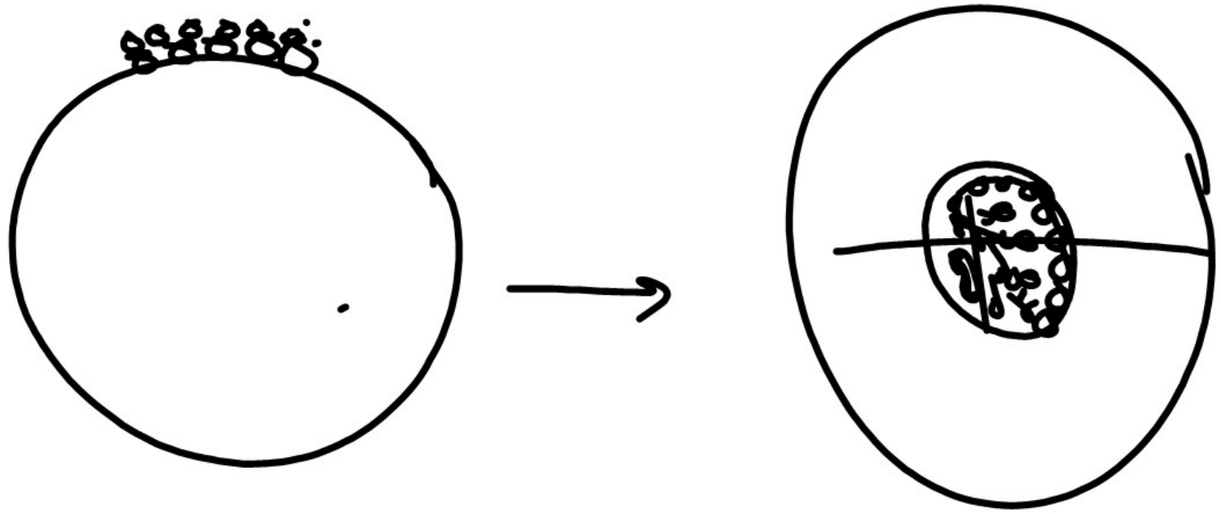
V. Plat

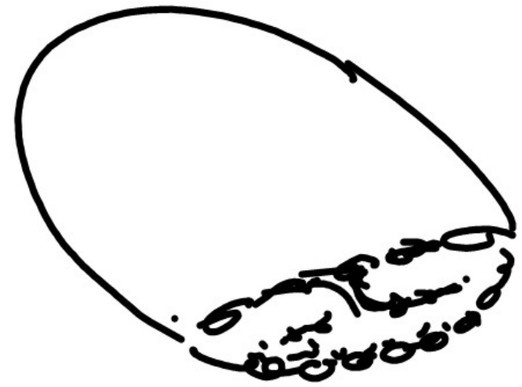
Ingression followed by Invagination


A.P
equator
V.P


ICM
Blastocoel
(Blastocyst
cavity)
OCM
Amniotic
cavity
Blastocyst







# Gastrulation

# Gastrulation

**Gastrulation** is a phase early in the embryonic development of most animals, during which the single-layered blastula is reorganized into a trilaminar ("three-layered") structure known as the gastrula. These three germ layers are known as the ectoderm, mesoderm, and endoderm.

•

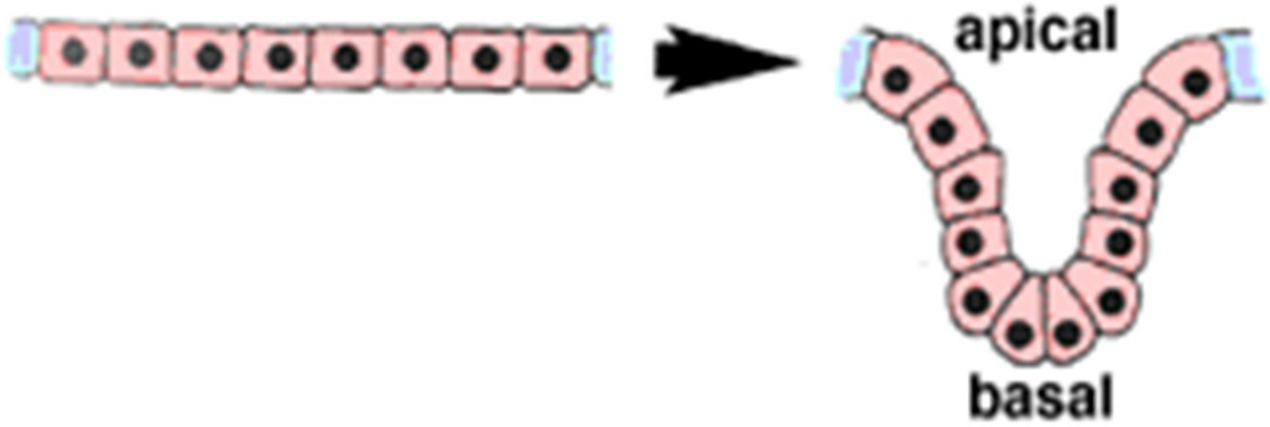
- **The most prominent features of gastrulation are:**
- 1. A rearrangement of cells of the embryo by means of morphogenetic movements(**MM**).
- 2. As a result of **MM**, the three germ layers are synthesized( ectoderm, mesoderm & endoderm)
- 3. The rhythm of cellular division is slowed down.

- 4. Growth is **insignificant**.
- 5. The type of metabolism changes; **oxidation is intensified.**
- 6. More gene expression.
- 7. Proteins of many new kinds, that were not present in the egg, begin to synthesized.
- 8. Embryo **axes** are determined.
- 9. Blastopore formation, so we can determine if the animal belongs to **protostomia** (fist mouth) or to **deuterostomia**(second mouth).

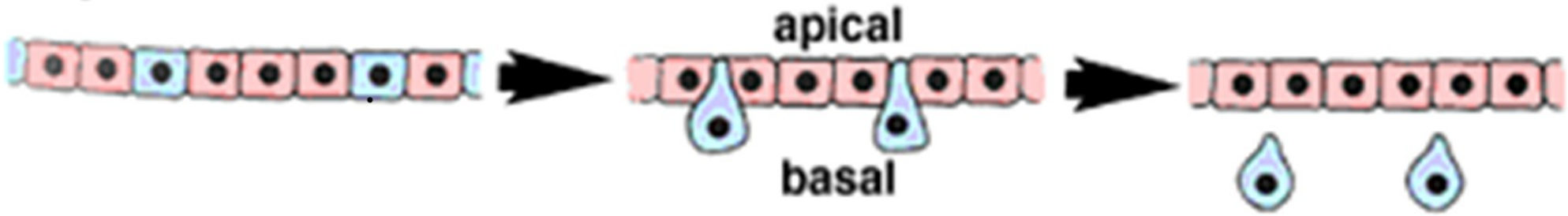
# Modes of Gastrulation

- The molecular mechanism and timing of gastrulation is different in different organisms:
- 1. Invagination
- 2. Ingression
- 3. Involution
- 4. Delamination

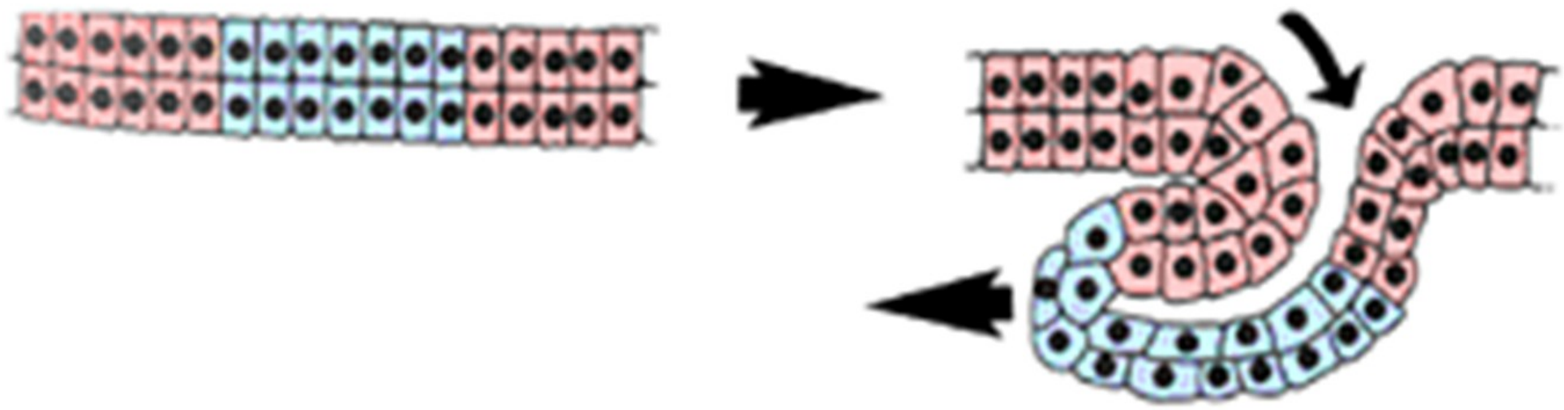
## Invagination




## Ingression

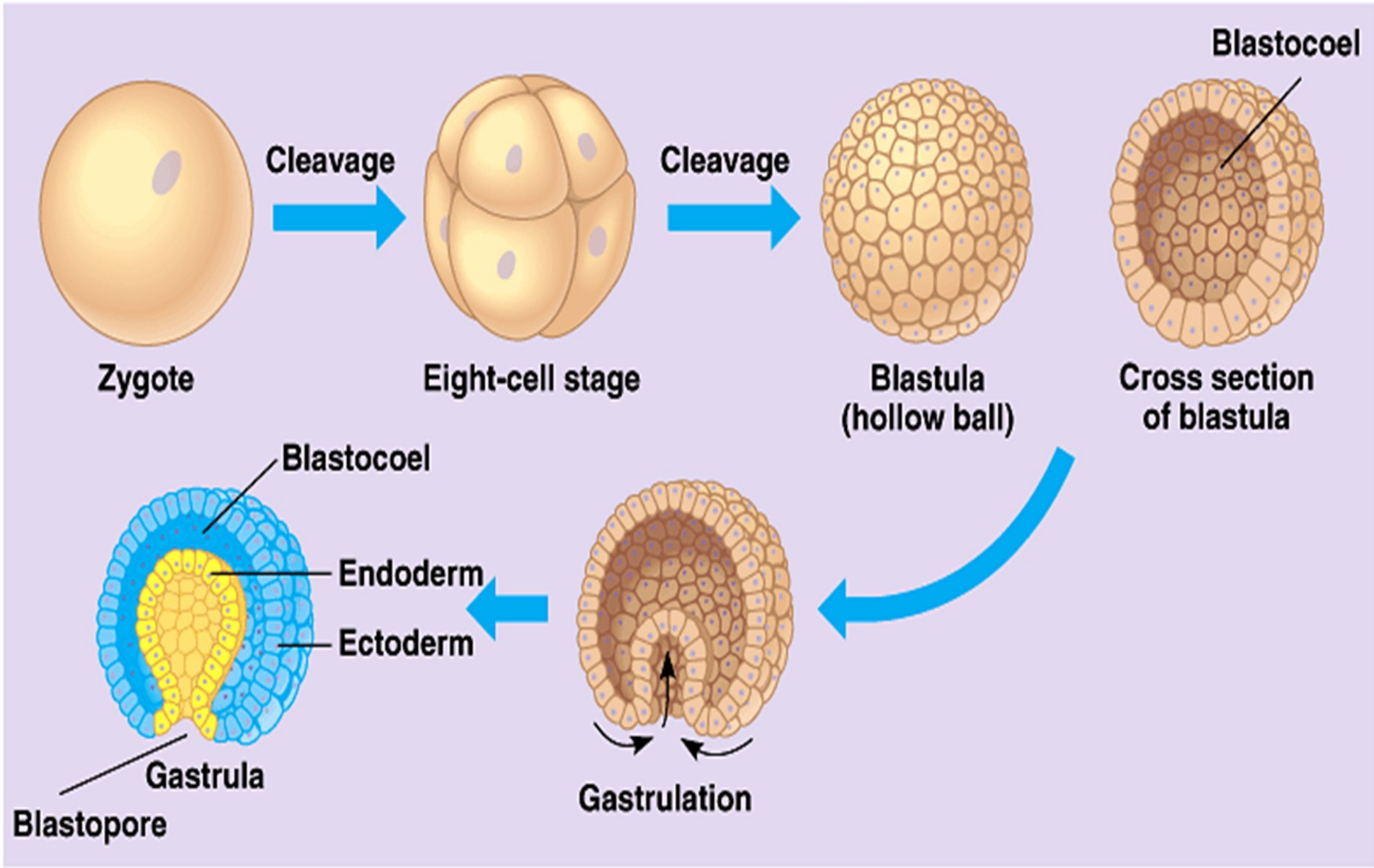



## Involution



# 1. Invagination

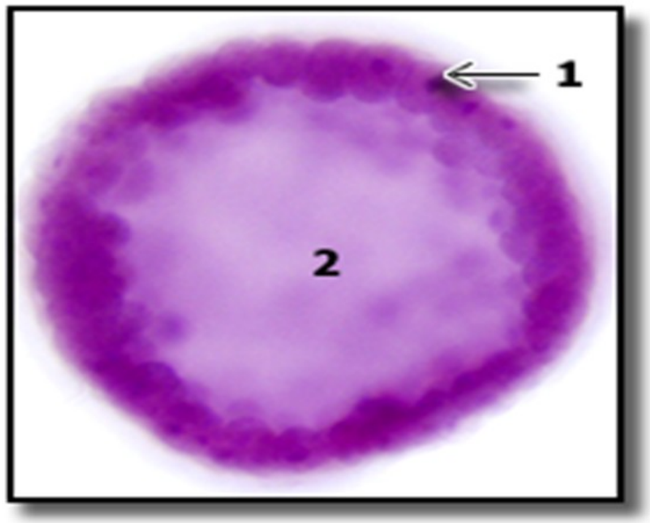
- An example of this mode of gastrulation occurs in **star fish.**
- 1. The first sign of gastrulation is the flattening of the blastula at the **vegetal pole.**
- 2. This flattened region then gradually folds inward, converting the spherical blastula into a cup-shaped gastrula.
- **During gastrulation, the blastocoele is obliterated and a new cavity, the gastrocoele or archenteron, is formed. The opening into the gastrocoele is the blastopore and develops into the anus in all deuterostomes.**



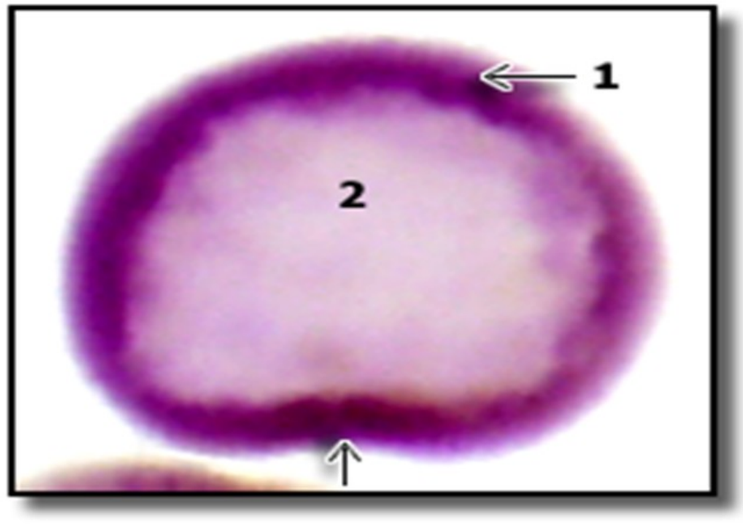
# Embryology - Starfish Later Cleavage Divisions and Gastrulation

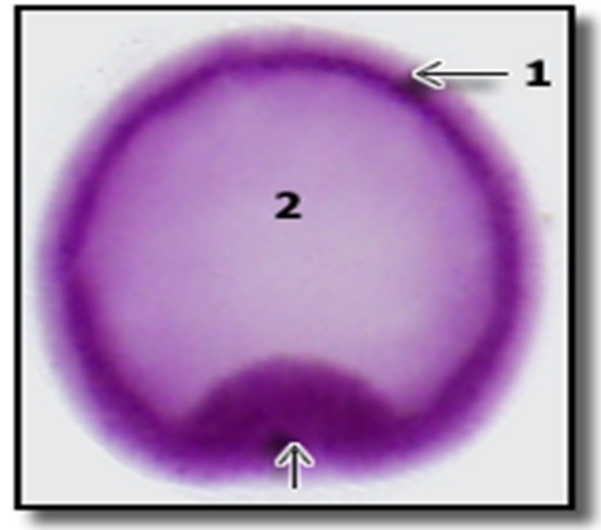
*Drag the cursor over the labels to identify the parts*

**Blastula**

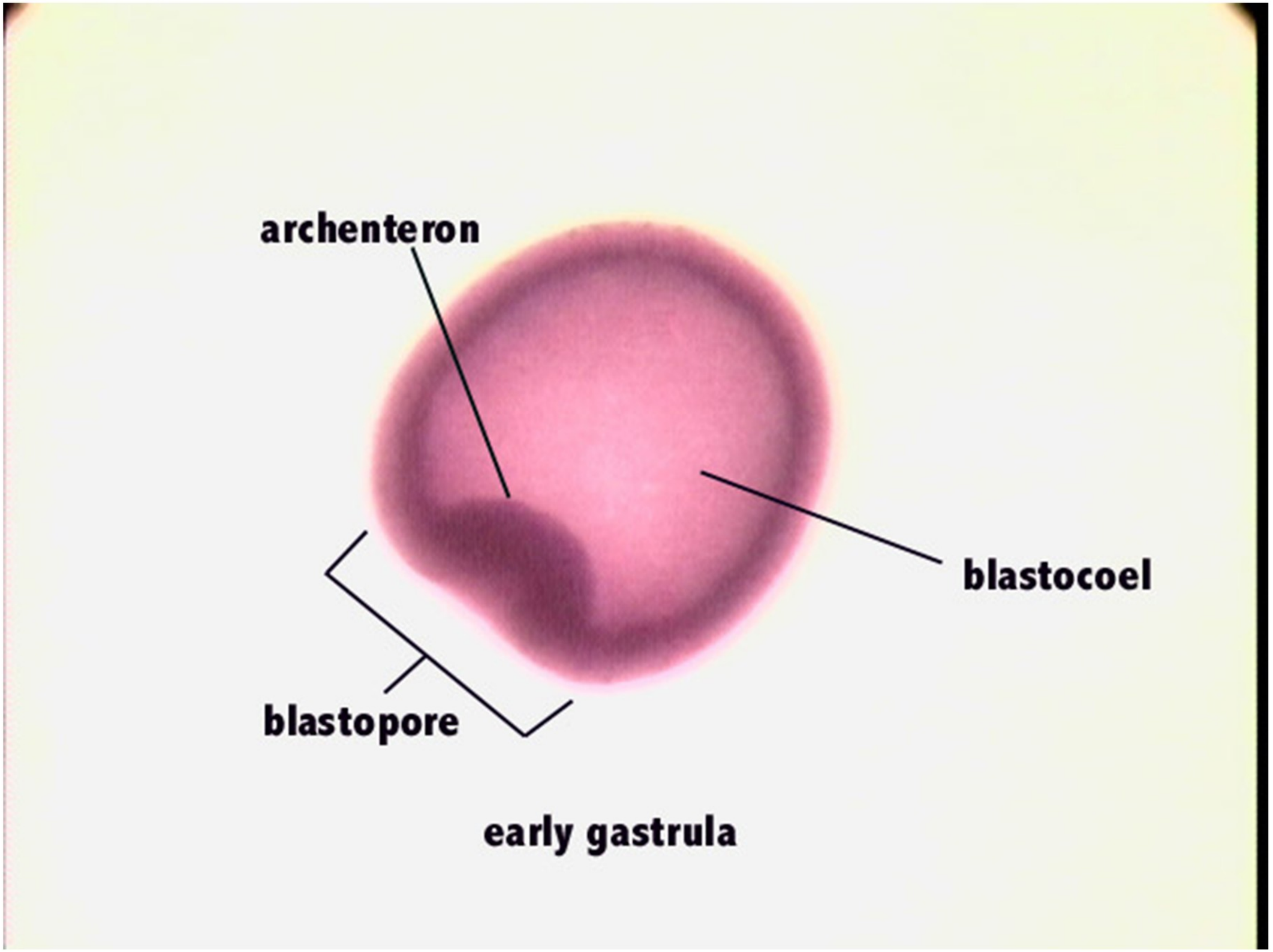



**Early Gastrulation**



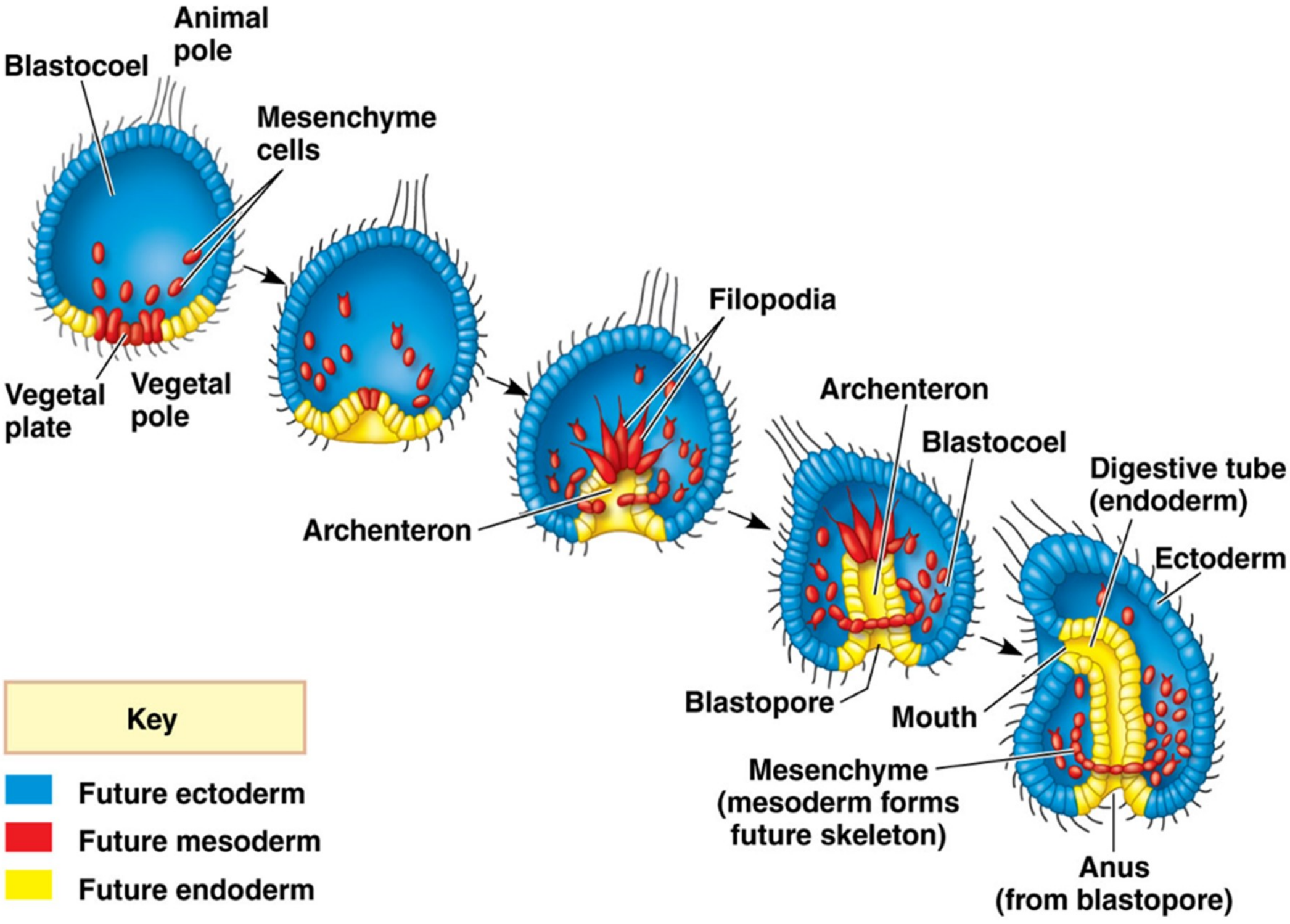



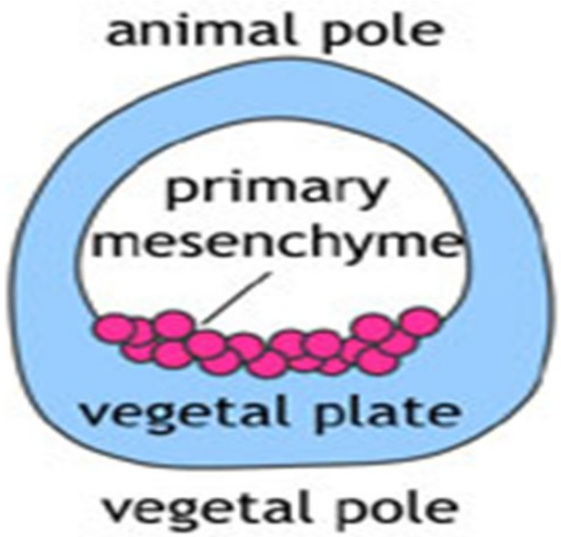

**Late Gastrulation**



archenteron
blastocoel
blastopore
early gastrula

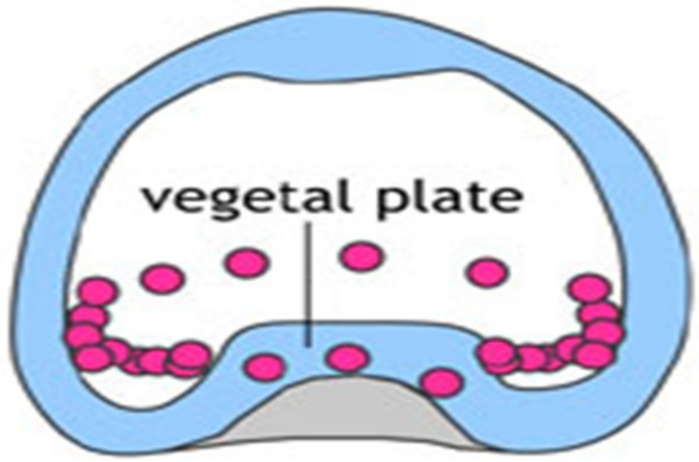
# 2.Ingression

- An example of this mode of gastrulation occurs in **sea urchin.**
- **Ingression:** individual surface cells migrate to the interior of the embryo.
- It produces an animal's **mesenchyme** cells at the onset of gastrulation.

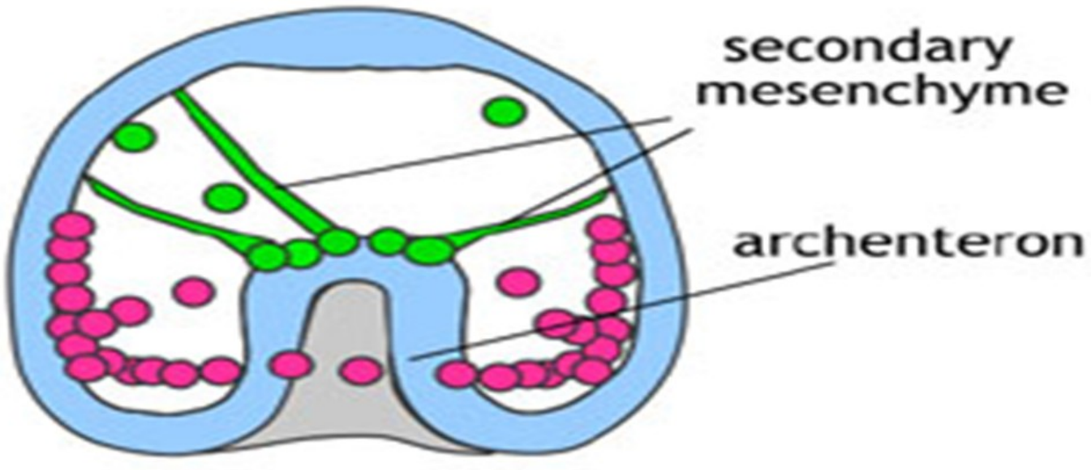




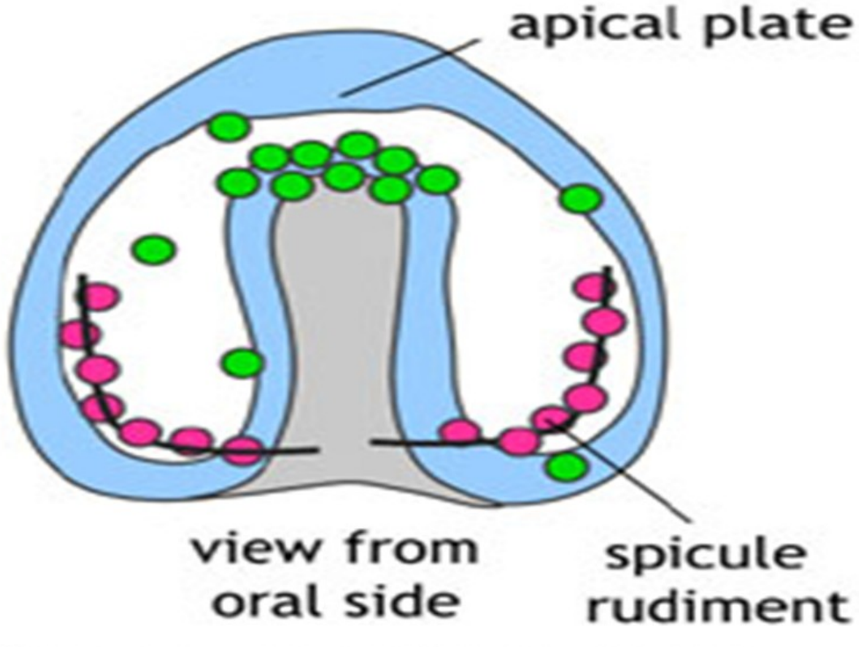

mesenchyme blastula



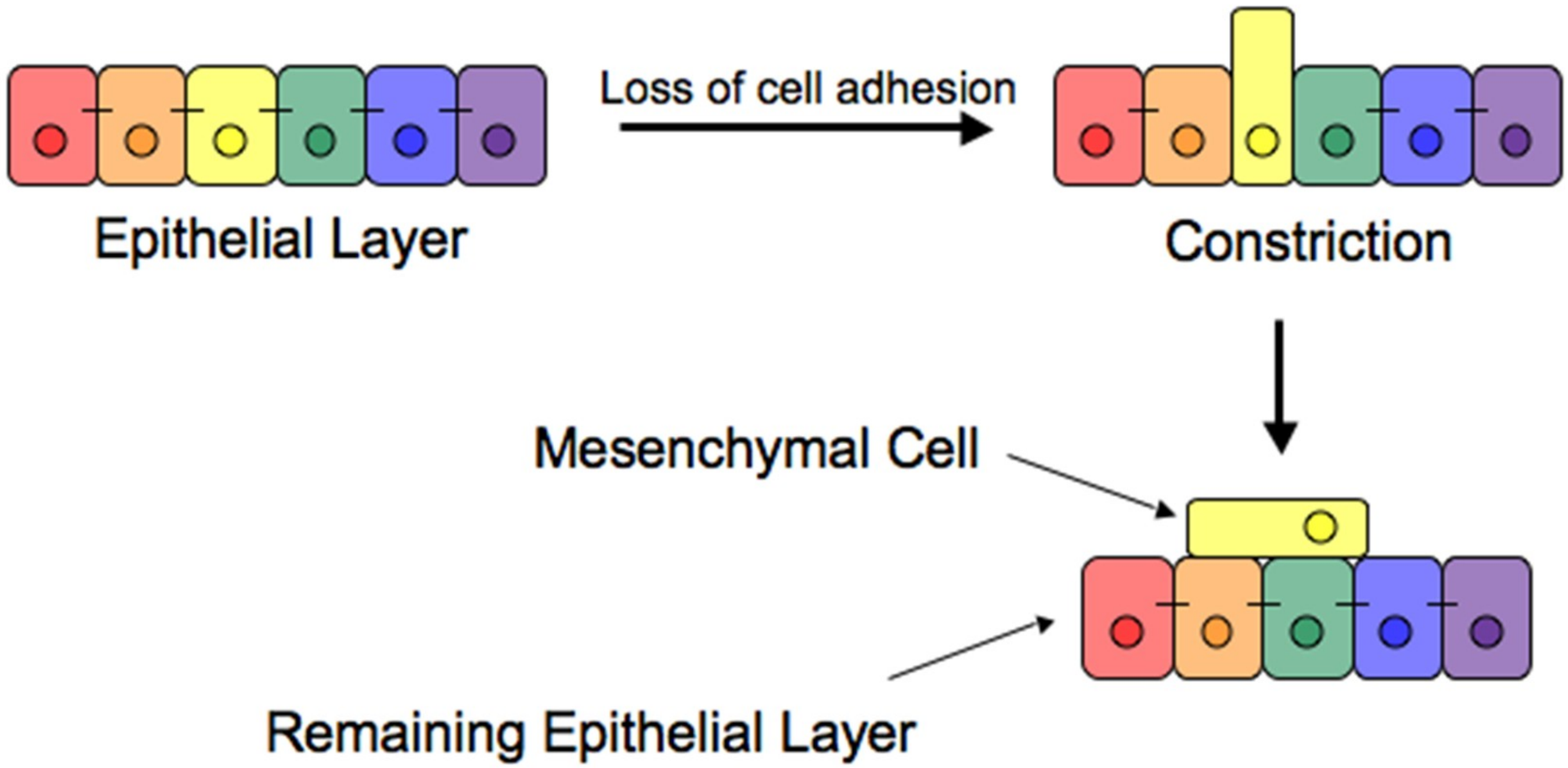

early gastrula

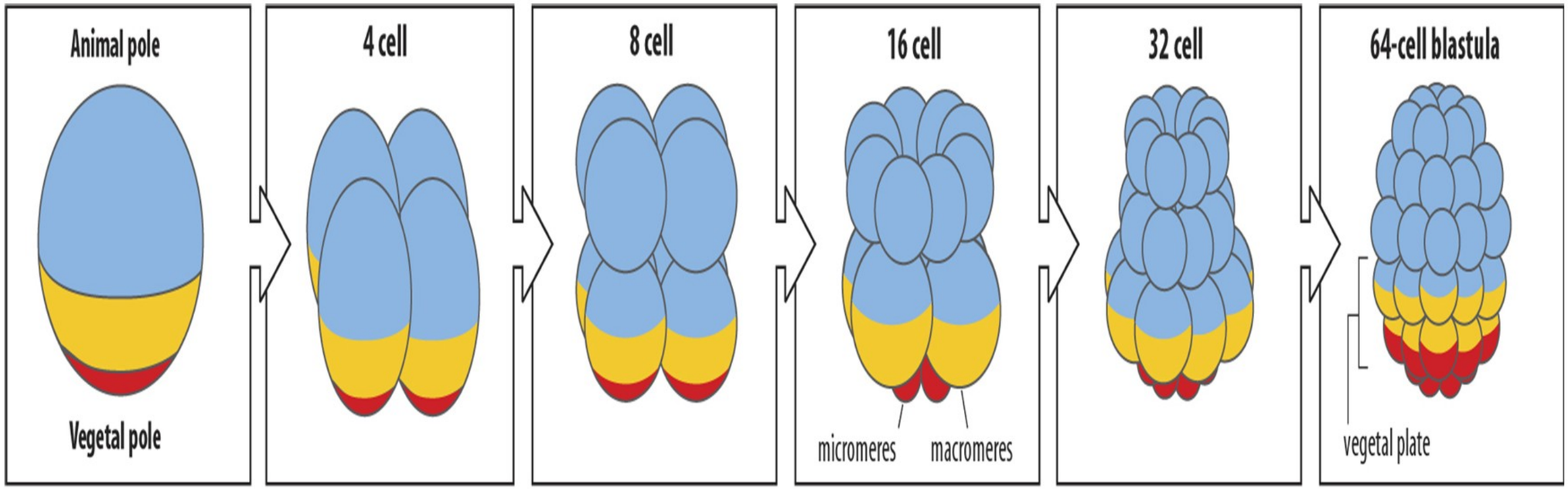



mid-gastrula



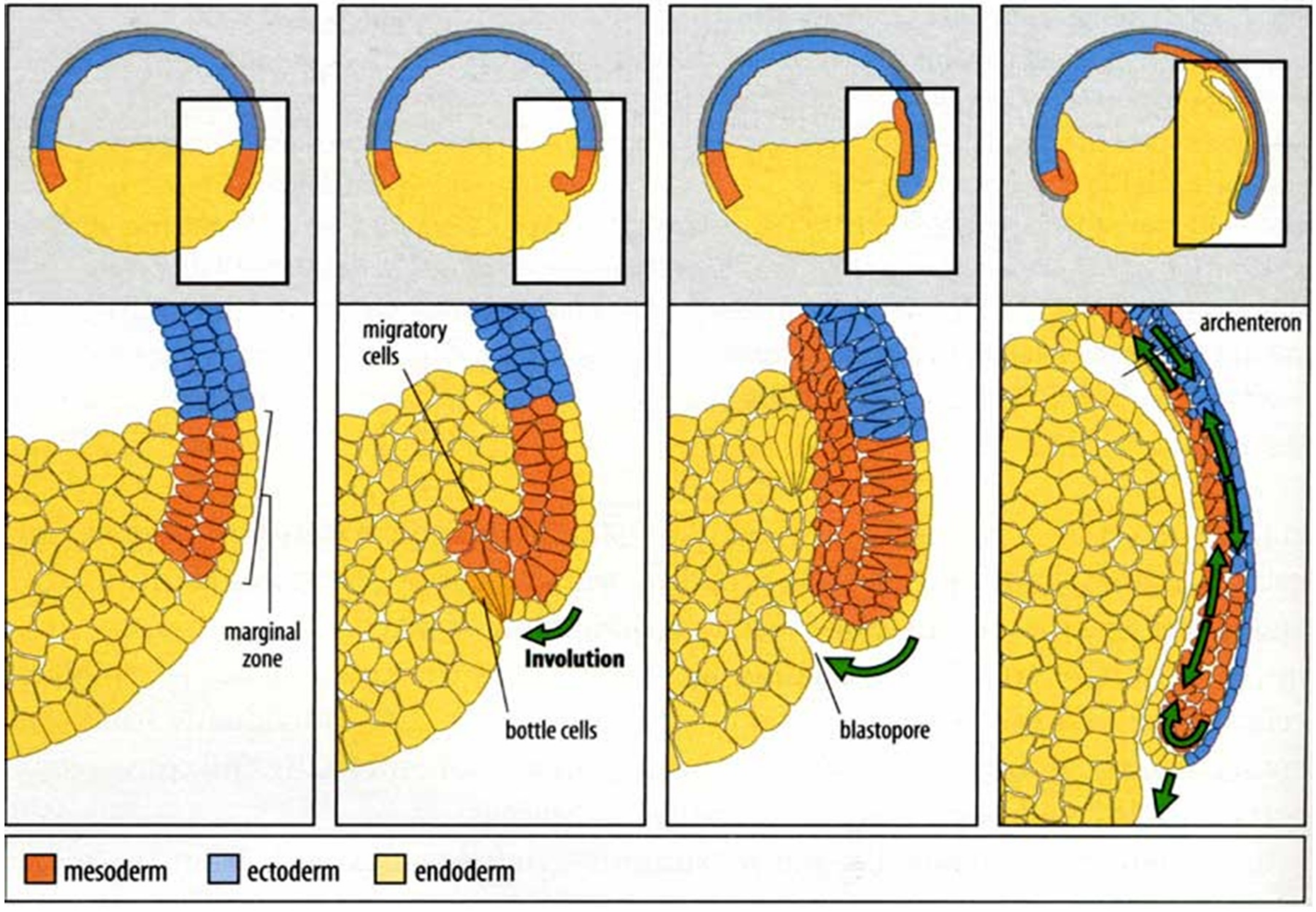

late gastrula/prism

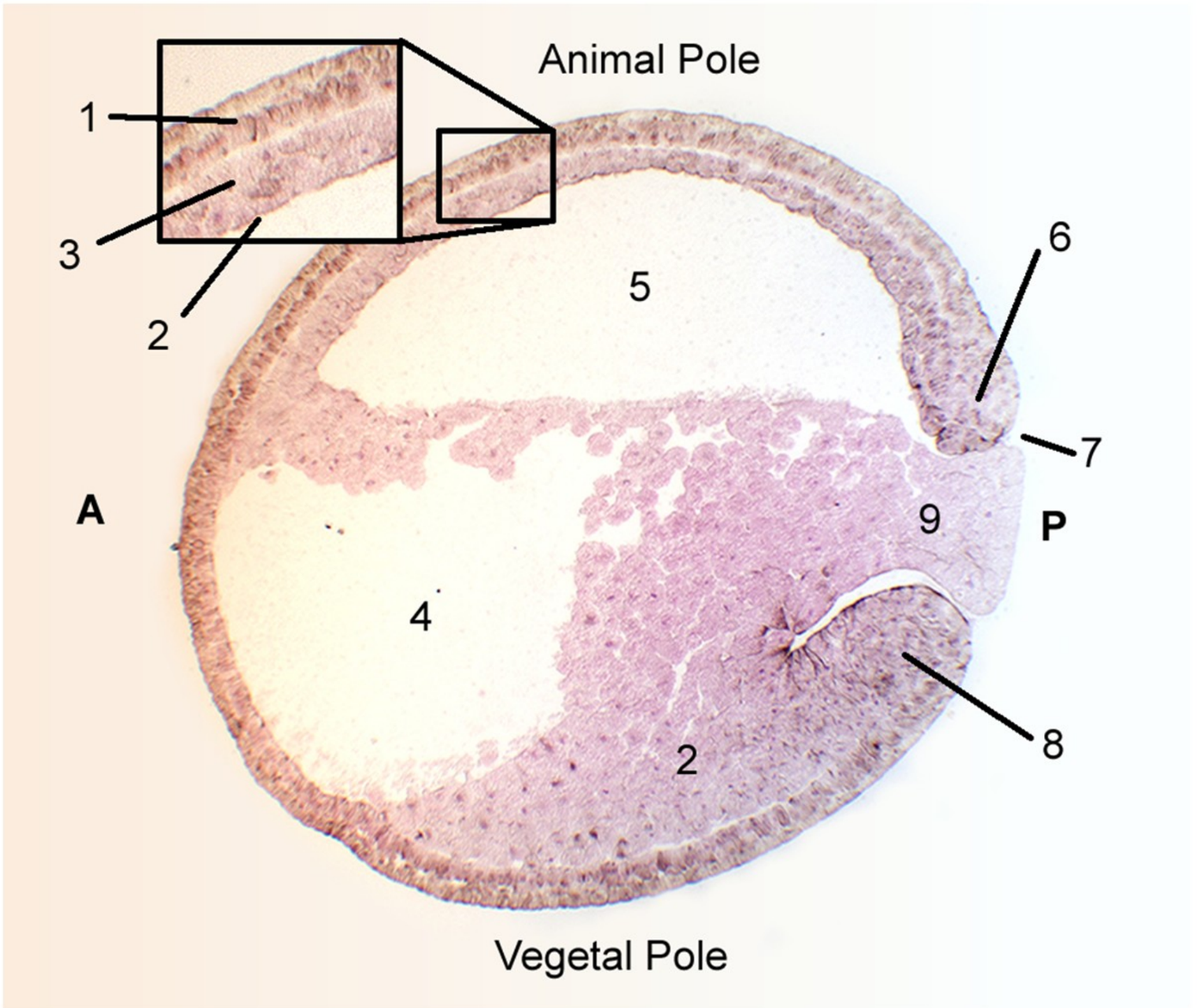

Loss of cell adhesion
Epithelial Layer
Constriction
Mesenchymal Cell
Remaining Epithelial Layer


Animal pole
Vegetal pole
4 cell
8 cell
16 cell
micromeres
macromeres
32 cell
64-cell blastula
vegetal plate
Blastula
Animal pole
Vegetal pole
primary mesenchyme
Gastrula
primary mesenchyme
secondary mesenchyme
O
Ab
gut
mouth
ectoderm
O
Ab
anus
Pluteus
skeletal rod
oral hood
anus

# 3. Involutiom

- An example of this mode of gastrulation occurs in **amphibian**.
- In frog embryos, gastrulation is initiated at the future dorsal side of the embryo, just **below the equator** in the region of the **grey crescent**.
- Here the marginal endodermal cells sinks into the embryo thus forming a slit like blastopore. These cells now change their shape and become **flask shaped**.

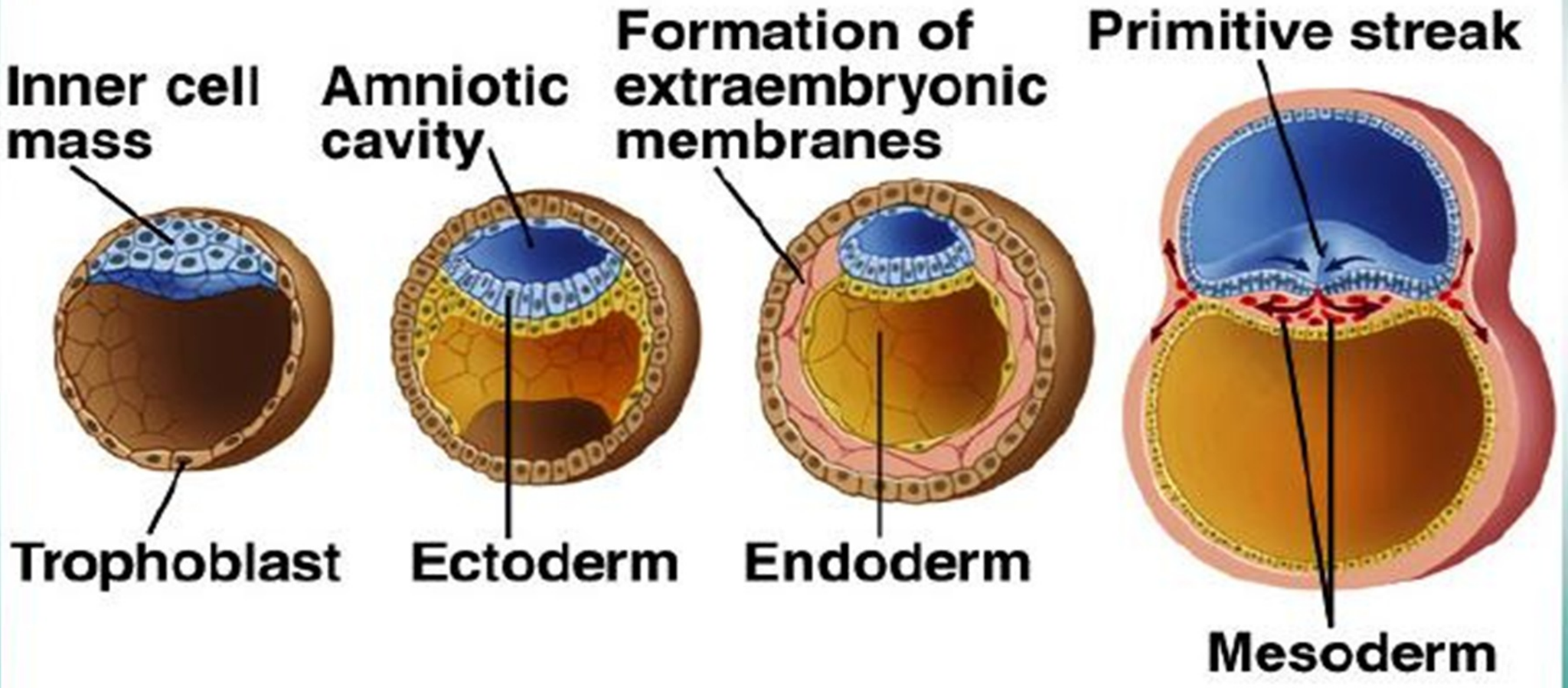

migratory cells
marginal zone
Involution
bottle cells
blastopore
archenteron
mesoderm
ectoderm
endoderm


Animal Pole
1
3
2
5
6
7
A
9
P
4
2
8
Vegetal Pole

# 4. Delamination

- An example of this mode of gastrulation occurs in **mammals** & **birds.**
- **Delamination :** sheet of cells split into separate layers.

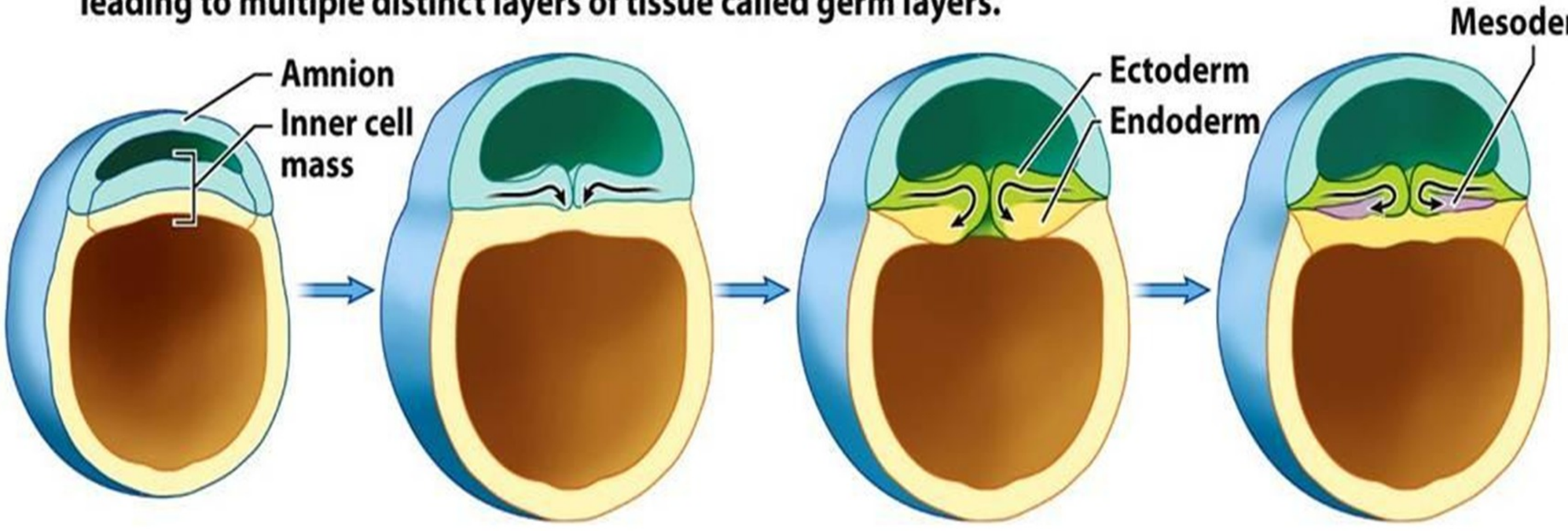
# Gastrulation — Mammal



| GERM LAYER | BECOMES |
|---|---|
| Ectoderm | Outer layer of skin, hair, lining of the nose and mouth, and the nervous system |
| Endoderm | Digestive tract, respiratory tract, liver, and pancreas |
| Mesoderm | Muscles and skeleton |

# GASTRULATION

**The second phase of development is gastrulation, a migration of blastocyst cells inward, leading to multiple distinct layers of tissue called germ layers.**




**Cells of the inner cell mass begin to differentiate as the amnion forms**

**A gastrula develops when cells begin to migrate inward, forming an indentation.**

**The cells continue to push inward, forming the endoderm. Cells that remain on the outer surface of the gastrula are called ectoderm.**

**The mesoderm is formed, as additional cells migrate inward between the endoderm and ectoderm.**

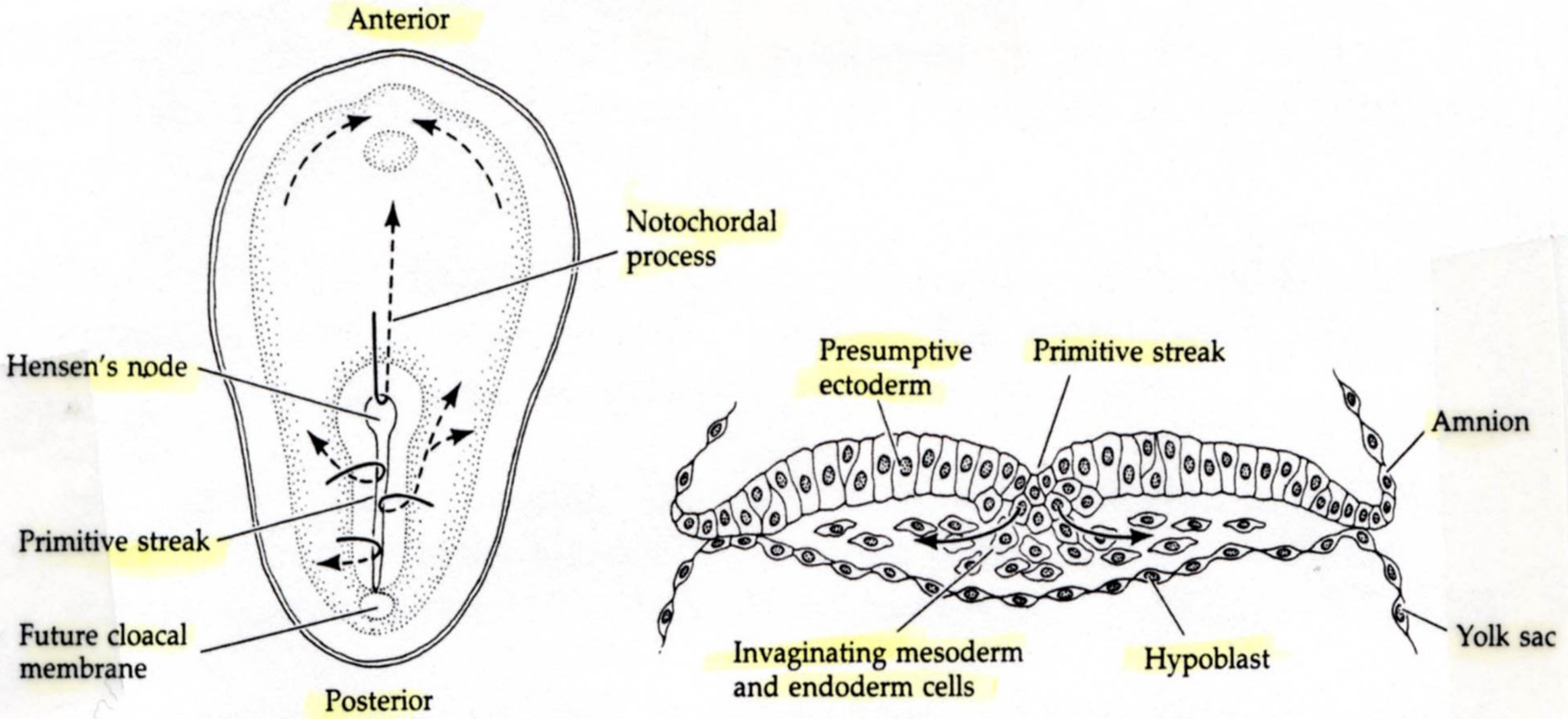
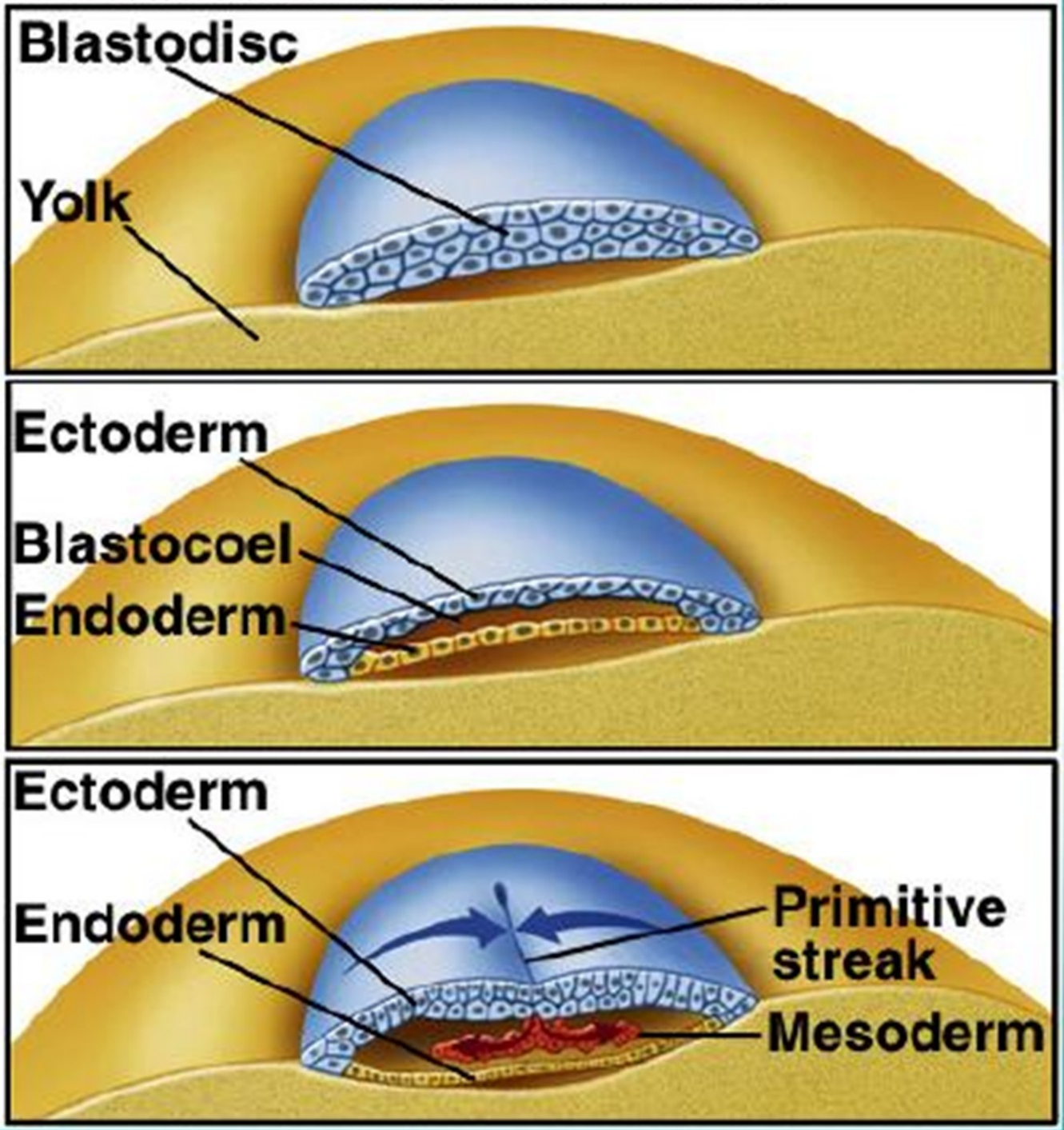
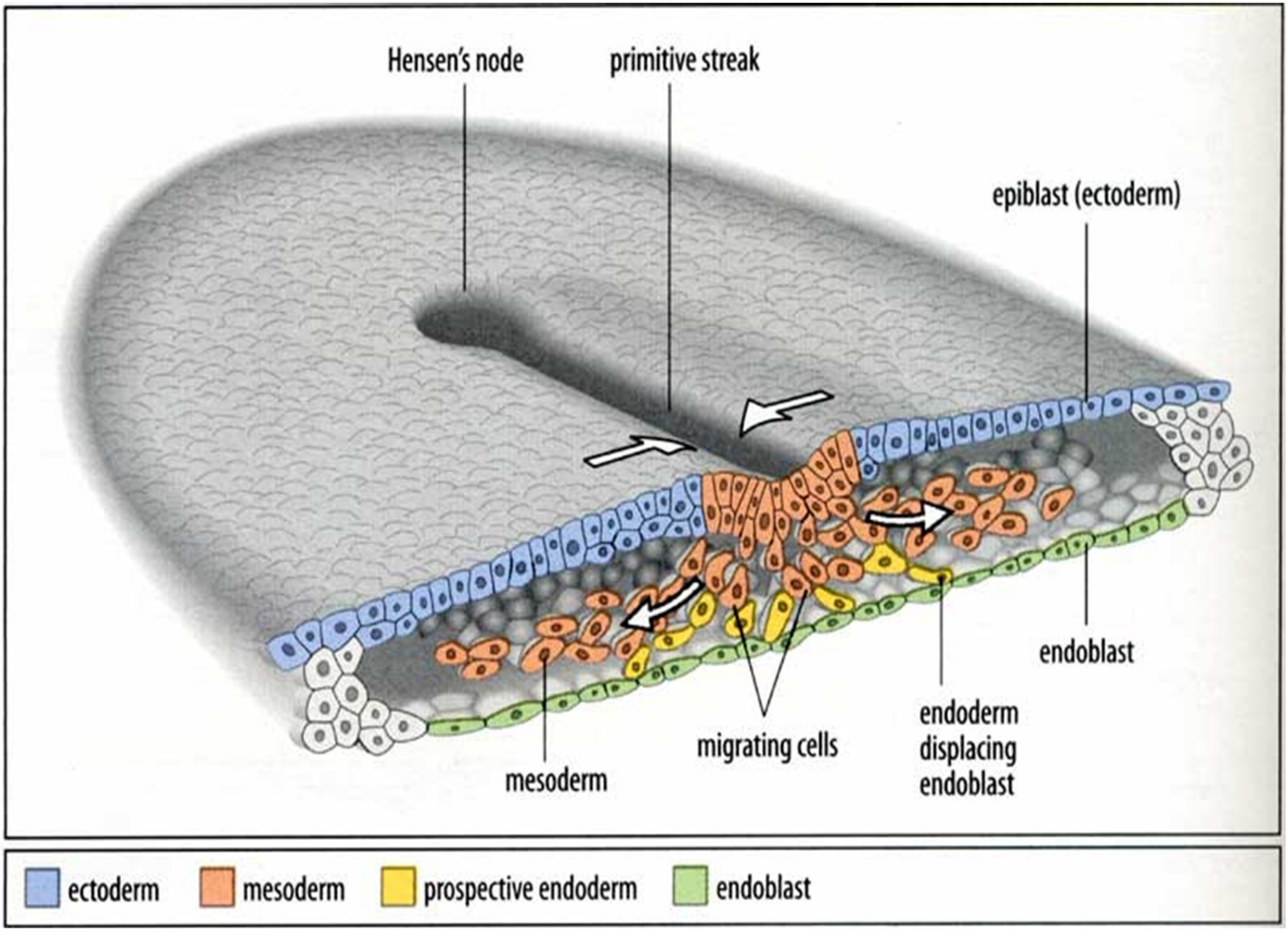
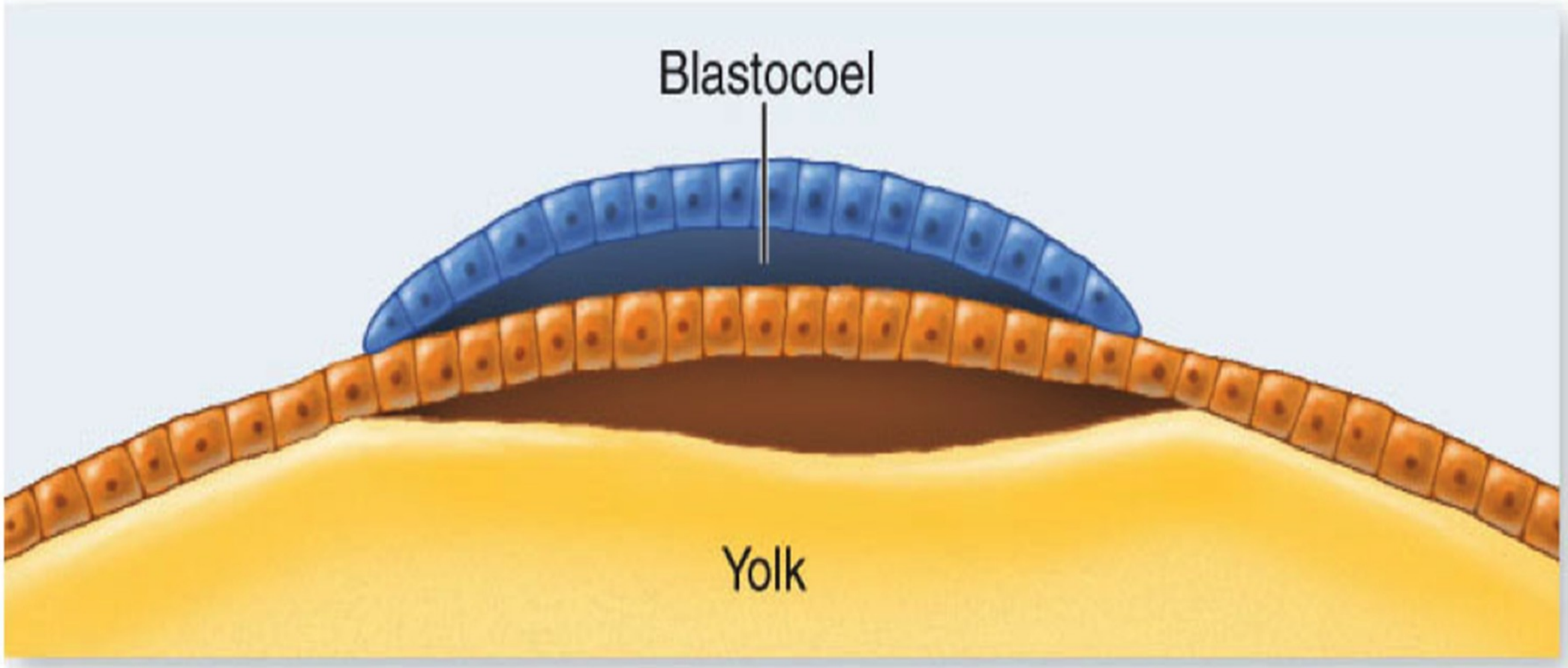



**FIGURE 42**
Cell movements during mammalian gastrulation. (A) Schematic diagram showing the dorsal surface of the embryonic epiblast (amniotic ectoderm removed). As in chick embryos, cells migrating through Hensen's node travel anteriorly (cephalad) to form the notochord, while the remaining cells traveling through the streak migrate laterally to become the mesoderm and endoderm precursors. Dotted lines indicate internal migrations. (B) Transverse section of the embryo. (After Langman, 1981.)

# Gastrulation — Bird




Hensen's node
primitive streak
epiblast (ectoderm)
endoblast
endoderm displacing endoblast
migrating cells
mesoderm
ectoderm
mesoderm
prospective endoderm
endoblast




*b.*