

# *Blastulation and Gastrulation*

*Dr . Rana Khalaf*

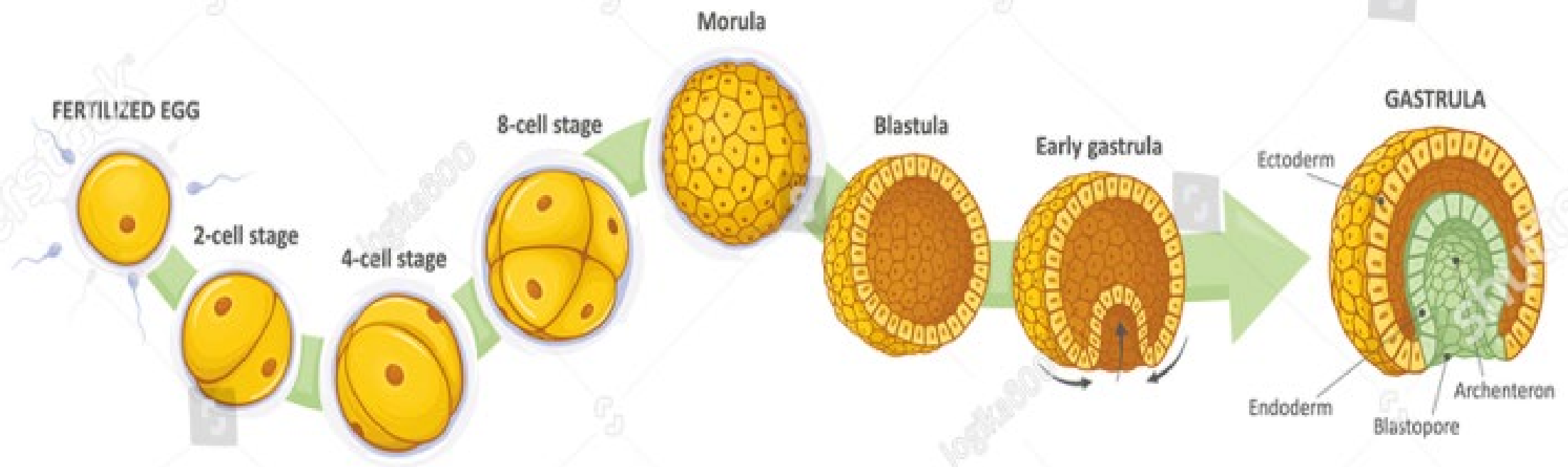
- **Pre-Blastula Development**

- The development of blastulation begins with fertilization.
- This is when two gametes come together and form a zygote.
- A zygote is when gametes (the egg and the sperm cell) come together to form a single cell.

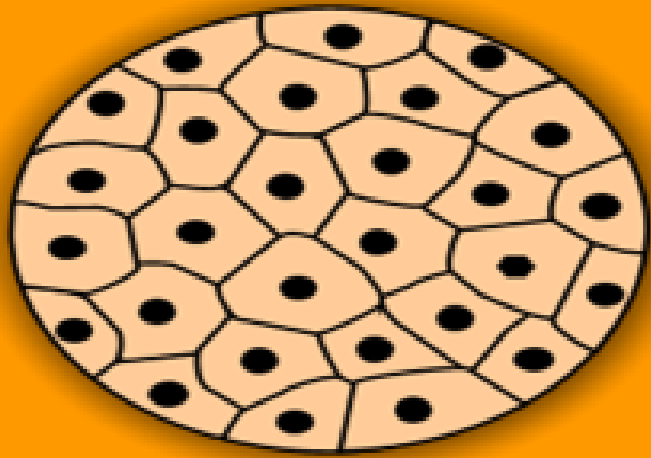
- Cells at this stage divide inwards but do not increase the total size, meaning the cells get smaller and smaller. This rapid cell division that occurs when the zygote transitions from a morula to a blastocyst is called **cleavage**.
- When there are 16-32 cells, the cell mass is called **a morula**.
-

- Formation of embryo from zygote includes following stages :
- Cleavage
- Blastulation
- Gastrulation
- Organogenesis

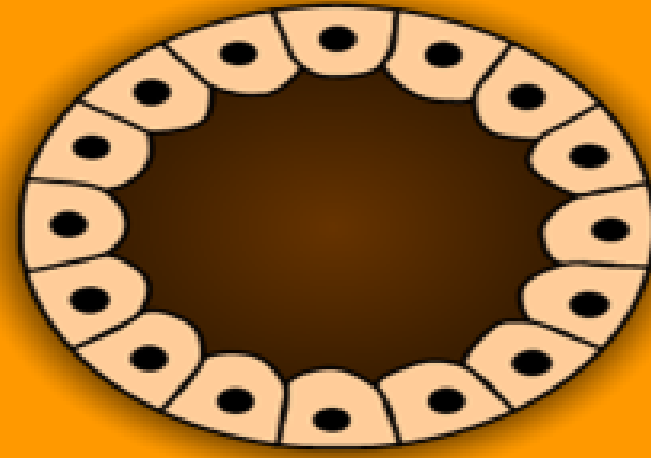
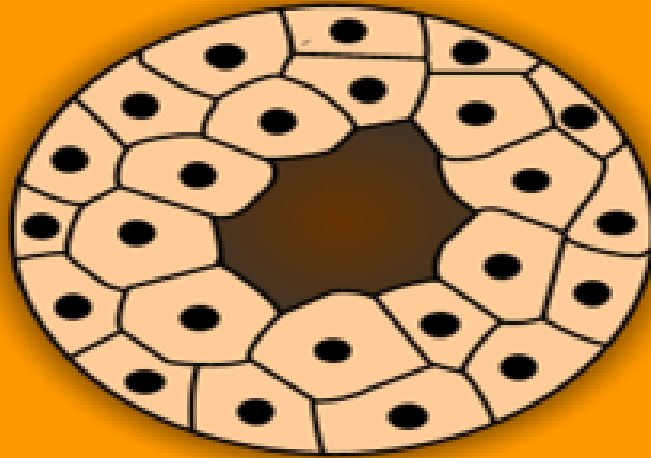
# HUMAN EMBRYONIC DEVELOPMENT



- A morula is a mass of cells that form a solid ball that is formed solely from the maternal mRNA as the gamete mRNA is not combined yet. Cells at this stage are called blastomeres.
- **Blastomeres** are cells that have divided after fertilization. At this stage, all blastomeres are not differentiated and are more or less the same.



1



2

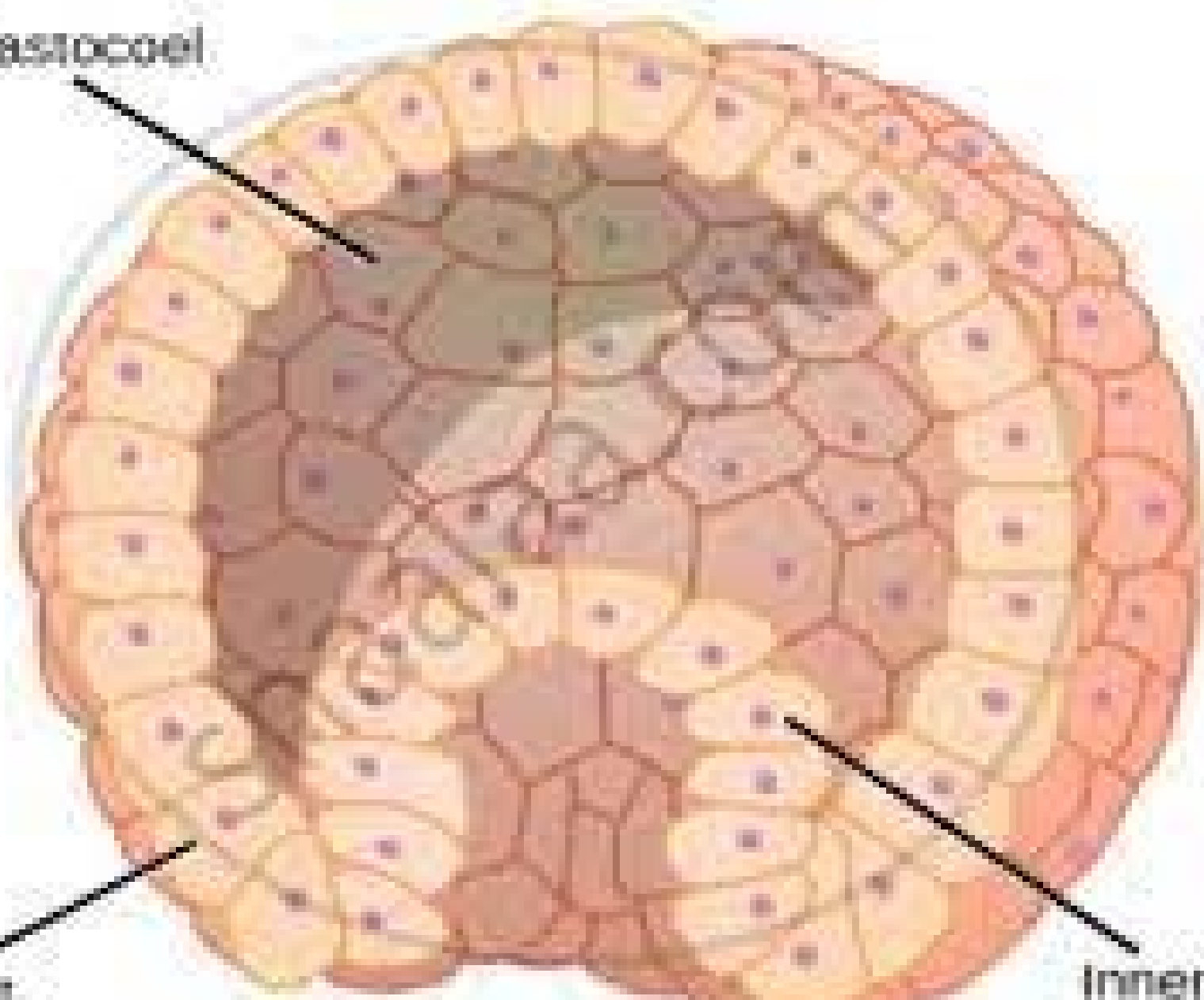
Blastulation: from 1. [morula](#) to 2. blastula

- The **blastula** is usually a spherical layer of cells (the blastoderm) surrounding a fluid-filled or yolk-filled cavity (the blastocoel).
- Each cell within the blastula is called a **blastomere**.



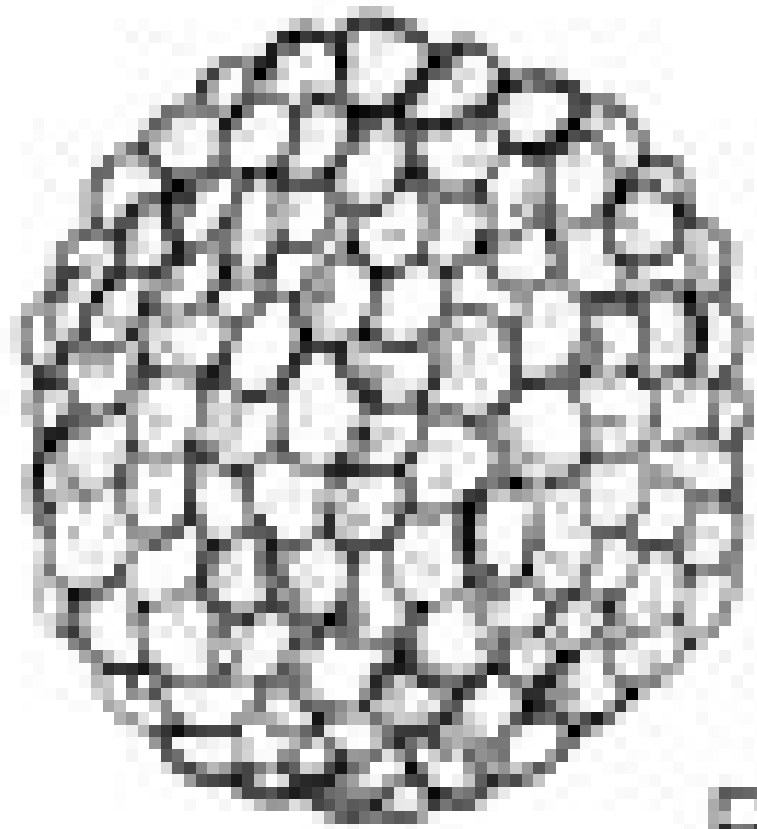
- The inner cell mass is also known as **the embryoblast**; this mass of cells will go on to form the embryo.
- At this stage of development, the inner cell mass consists of embryonic stem cells that will differentiate into the different cell types needed by the organism.

Blastocoel



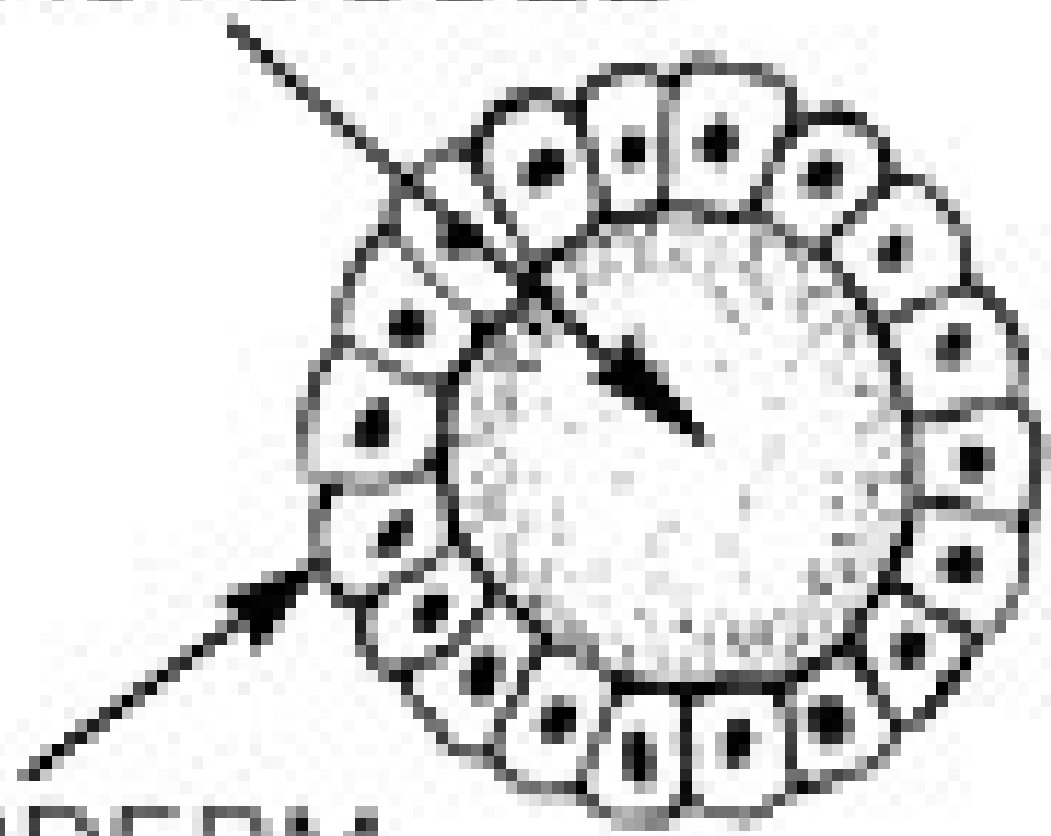
Trophoblast

inner cell mass



A

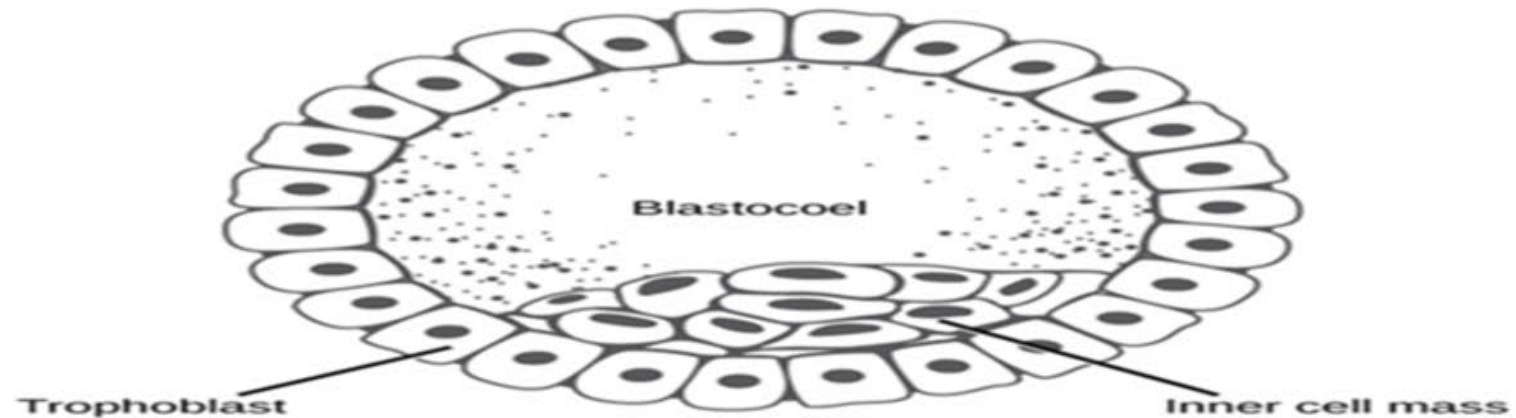
BLASTOCOEL



BLASTODERM

B

The outer layer The trophoblast will contribute to the placenta and nourish the embryo.



The inner cell mass is also known as **the embryoblast**; this mass of cells will go on to form the embryo.

At this stage of development, the inner cell mass consists of embryonic stem cells that will differentiate into the different cell types needed by the organism.

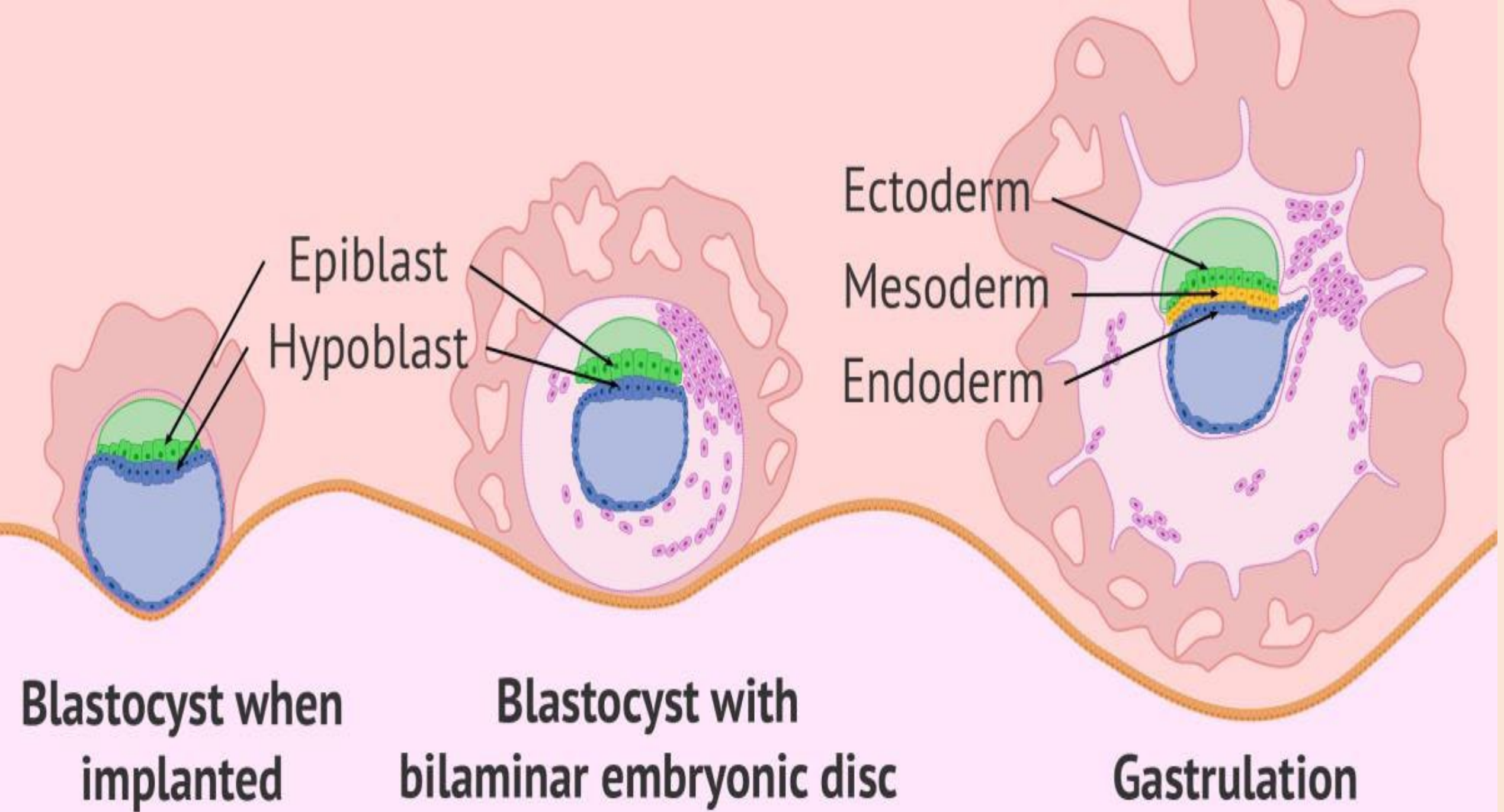
The outer layer The trophoblast will contribute to the placenta and nourish the embryo

- The cells of the inner cell mass
- spread into a flattened tissue layer and differentiate into a two-layered tissue containing epiblast (columnar epithelial cells) will form a yolk sac.
- The primitive streak forms as differential cell growth generates a pair of ridges separated by a depression

The primitive streak defines the longitudinal axis of the embryo and indicates the start of germ layer formation).

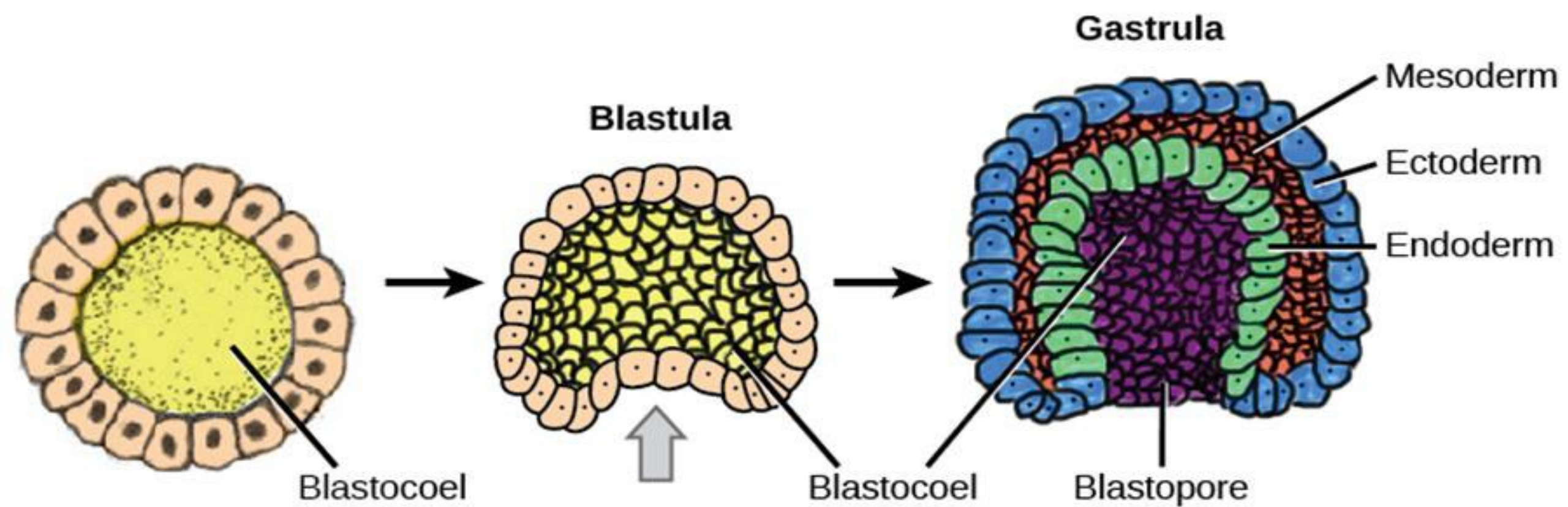
- The remaining inner cell mass may be called **the epiblast** and **hypoblast** (cuboidal epithelial cells), which are together known as the bilaminar embryonic disc
- The cells in the blastula then rearrange themselves spatially to form three layers of cells. This process is called **gastrulation**





- The gastrulation is marked by the appearance of the primitive streak, a groove in the caudal end of the epiblast layer Thus, the formation of the primitive streak firmly establishes the cranial/caudal axis.

- The **primitive streak** initially forms via a thickening of cells near the connecting stalk. As cells proliferate and migrate toward the midline of the embryo, the thickening elongates to become linear in shape, thus the term primitive streak.

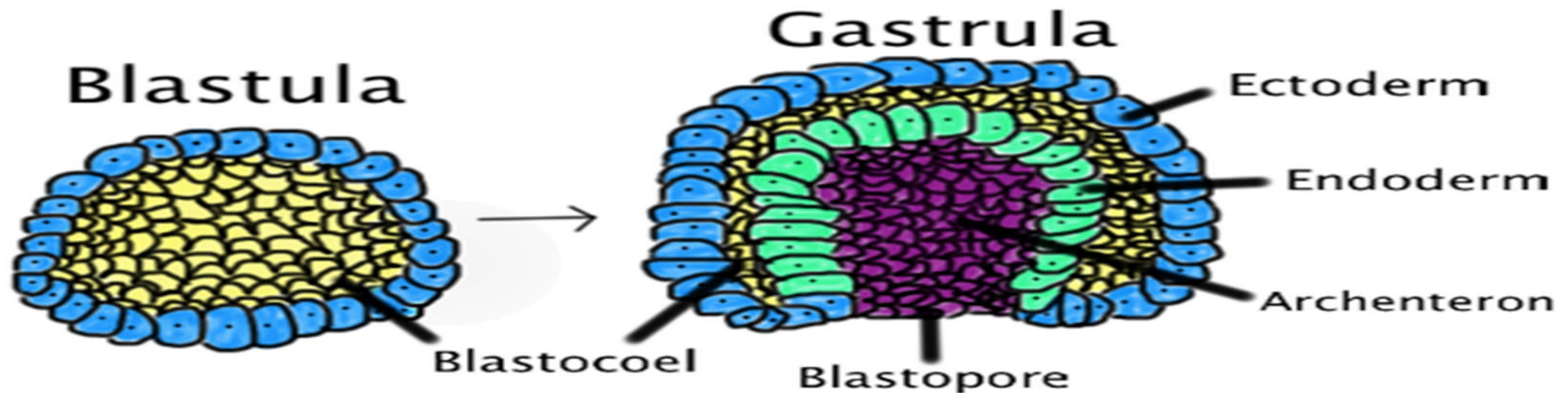


The three germ layers are the endoderm, the ectoderm, and the mesoderm. Cells in each germ layer differentiate into tissues and embryonic organs.

- In the mammalian blastocyst there are three lineages that give rise to later tissue development. The epiblast gives rise to the fetus itself while the trophoblast develops into part of the placenta and the primitive endoderm becomes the yolk sac.
- The typical blastula is a ball of cells.
- The next stage in embryonic development is the formation of the body plan.



- The cells in the blastula rearrange themselves spatially to form three layers of cells in a process known as gastrulation



# Blastula of Mammals and Birds

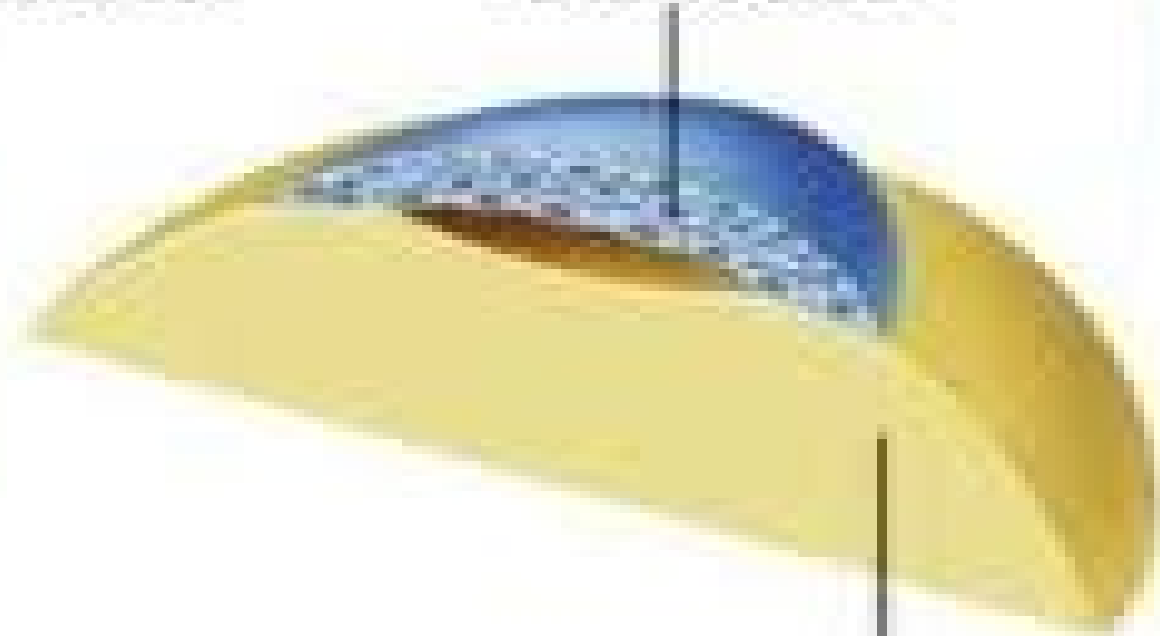
Inner cell mass

Blastocoel

Blastodisc

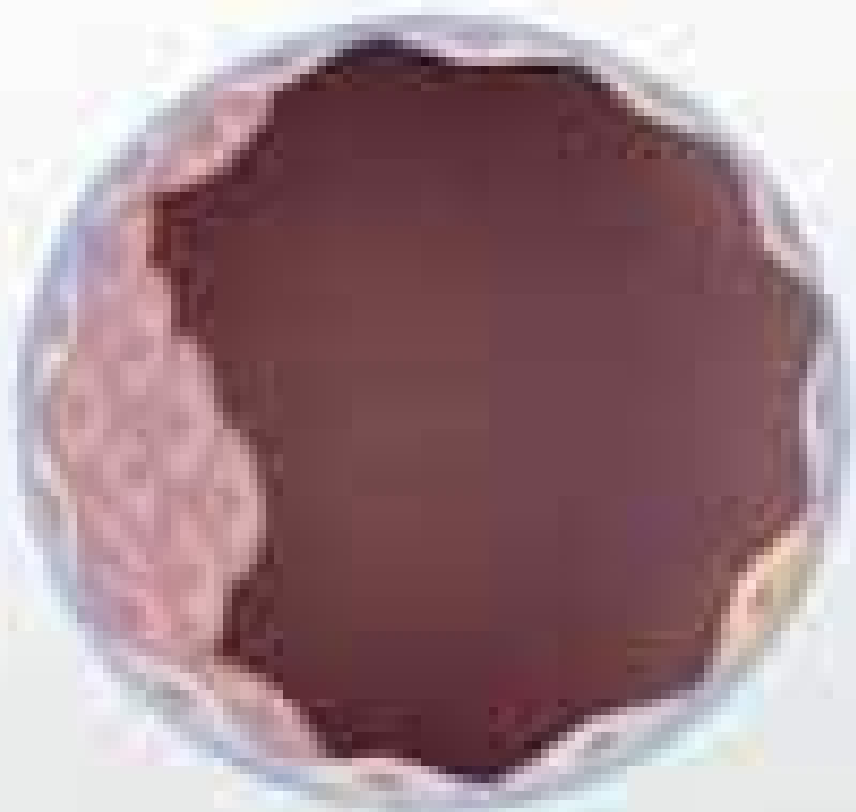


Trophoblast



Yolk

- Cap of cells develops into a blastodisc
- Blastocoel develops in mammals, surrounded by trophoblast



***Mammalian  
Blastula***

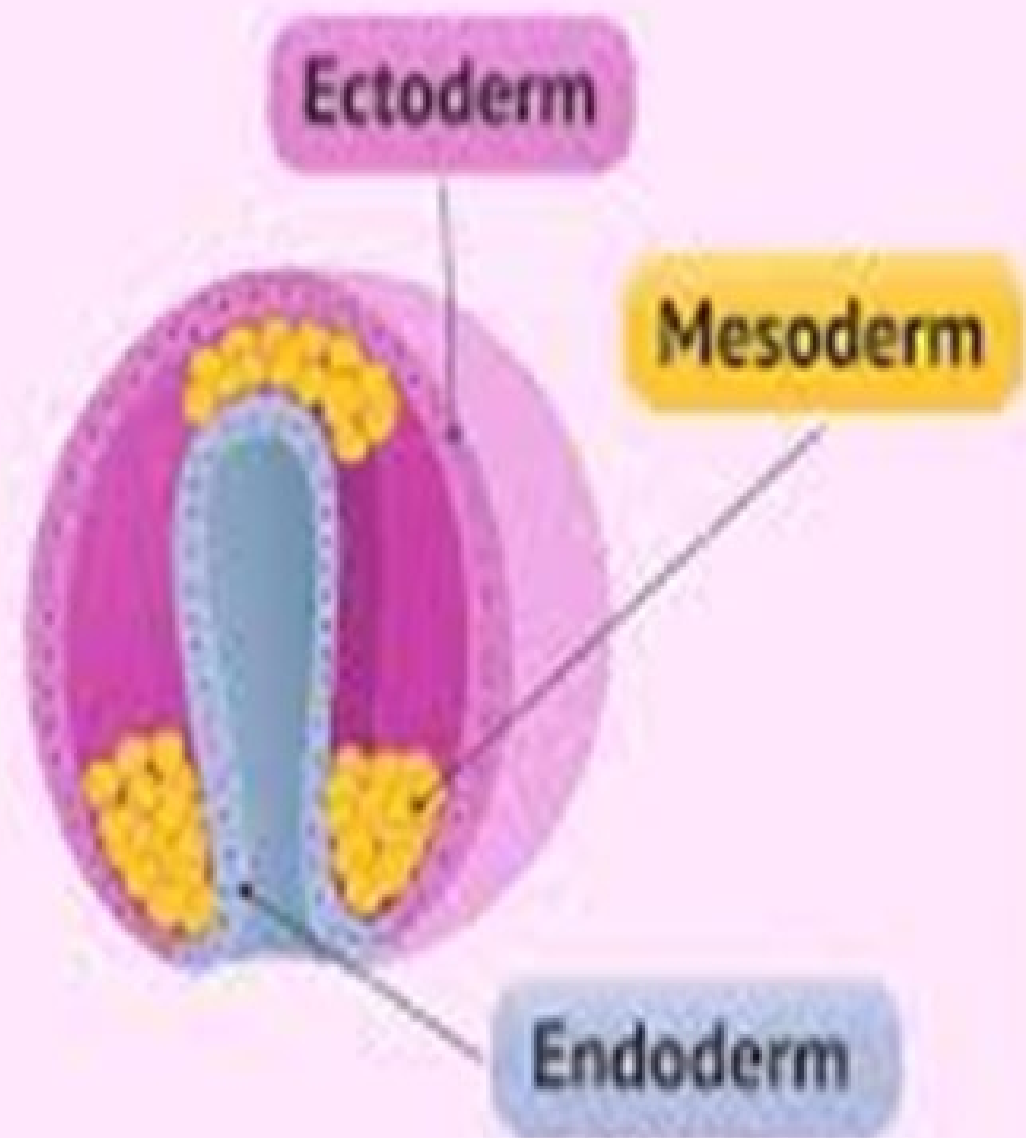


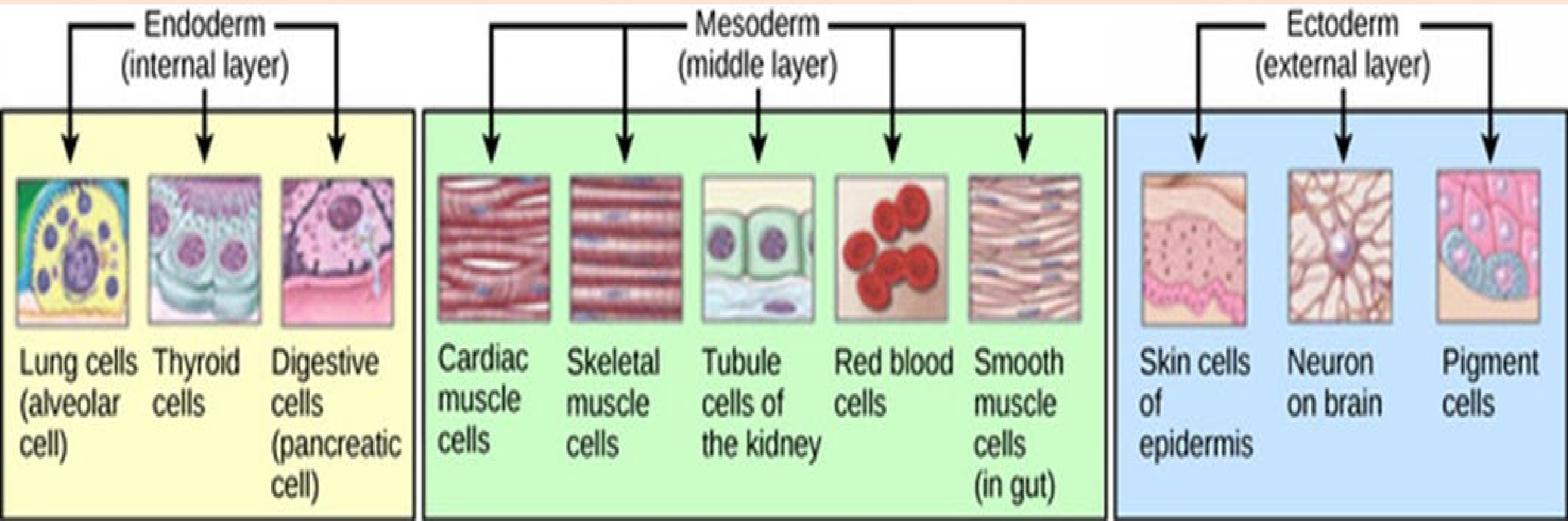
***Non-Mammalian  
Blastula***



- **Gastrulation** leads to the formation of the three germ layers that give rise during further development to the different organs in the animal body.
- **organogenesis** is process of organs develop from the germ layers through the process of differentiation of cell.

- The three germ layers are the **endoderm**, the **ectoderm**, and the **mesoderm**.
- The **ectoderm** gives rise to the nervous system and the epidermis.
- The **mesoderm** gives rise to the muscle cells and connective tissue in the body
- The **endoderm** gives rise to columnar cells found in the digestive system and many internal organs.





Endoderm  
(internal layer)

Mesoderm  
(middle layer)

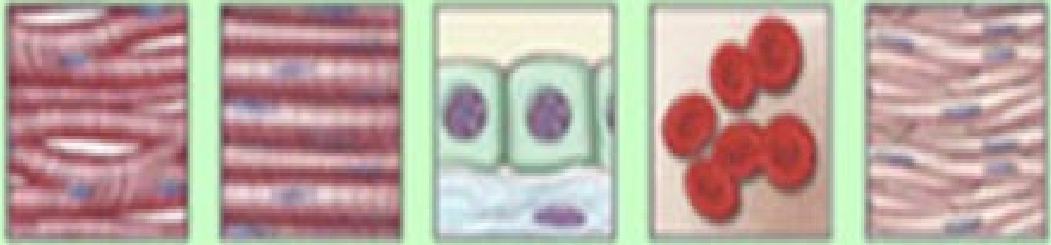
Ectoderm  
(external layer)



Lung cells  
(alveolar  
cell)

Thyroid  
cells

Digestive  
cells  
(pancreatic  
cell)



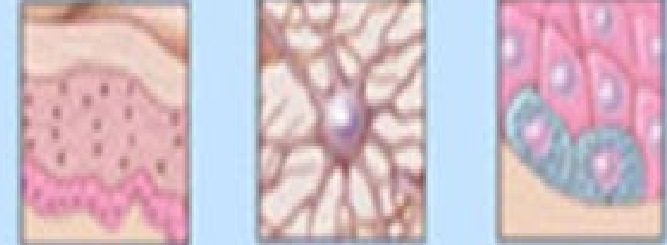
Cardiac  
muscle  
cells

Skeletal  
muscle  
cells

Tubule  
cells of  
the kidney

Red blood  
cells

Smooth  
muscle  
cells  
(in gut)



Skin cells  
of  
epidermis

Neuron  
on brain

Pigment  
cells

<b>Ectoderm</b>	<b>Mesoderm</b>	<b>Endoderm</b>
Skin	Muscle	Lung
Neurons	Kidney	Thyroid
Hair	Red blood cells	Pancreas
Nails	Gonads	Digestive tract
Eye lens	Heart	Bladder
Tooth enamel	Spleen	

## Differences between blastula and gastrula:

Blastula	Gastrula
<b>1. Blastula at the stage following the morula.</b>	1. Gastrula is an embryo at the stage following the blastula when it is a hollow-cup-shaped structure having three layers of cells.
<b>2. A single-layered hollow structure.</b>	2. A three-layered, hollow structure.
<b>3. Results from rapid mitotic cell division.</b>	3. Results from slow meiotic cell division.
<b>4. Contains 128 cells.</b>	4. Contains more cells than blastula.