

EMBRYOLOGY

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قال تعالى: "وَلَقَدْ خَلَقْنَا الْإِنْسَانَ مِنْ سُلَالَةٍ مِّنْ طِينٍ * ثُمَّ جَعَلْنَاهُ نُطْفَةً فِي قَرَارٍ مَّكِينٍ * ثُمَّ نَحْنُ نَخْلُقُنَا الْإِنْسَانَ مِنْ نُطْفَةٍ عَاقَّةٍ فَخَلَقْنَا الْعَاقَةَ مُضْغَةً فَخَلَقْنَا الْمُضْغَةَ عِظَامًا فَكَسَوْنَا الْعِظَامَ لَحْمًا ثُمَّ أَنْشَأْنَاهُ خَلْقًا آخَرَ فَتَبَارَكَ اللَّهُ أَحْسَنُ الْخَالِقِينَ"

(المؤمنون، آية: 12 - 14)

INTRODUCTION

Embryology

1: A branch of biology dealing
With embryos and their development

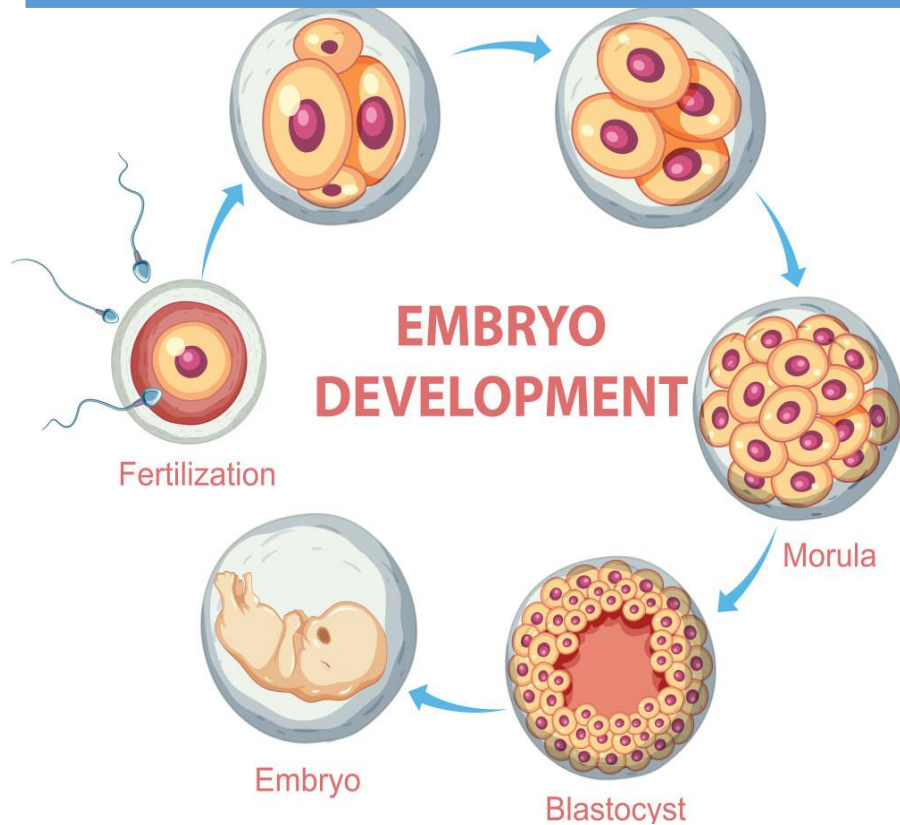
2: The features and phenomena exhibited in
the formation and development of an embryo.

INTRODUCTION [EMBRYO vs FETUS]

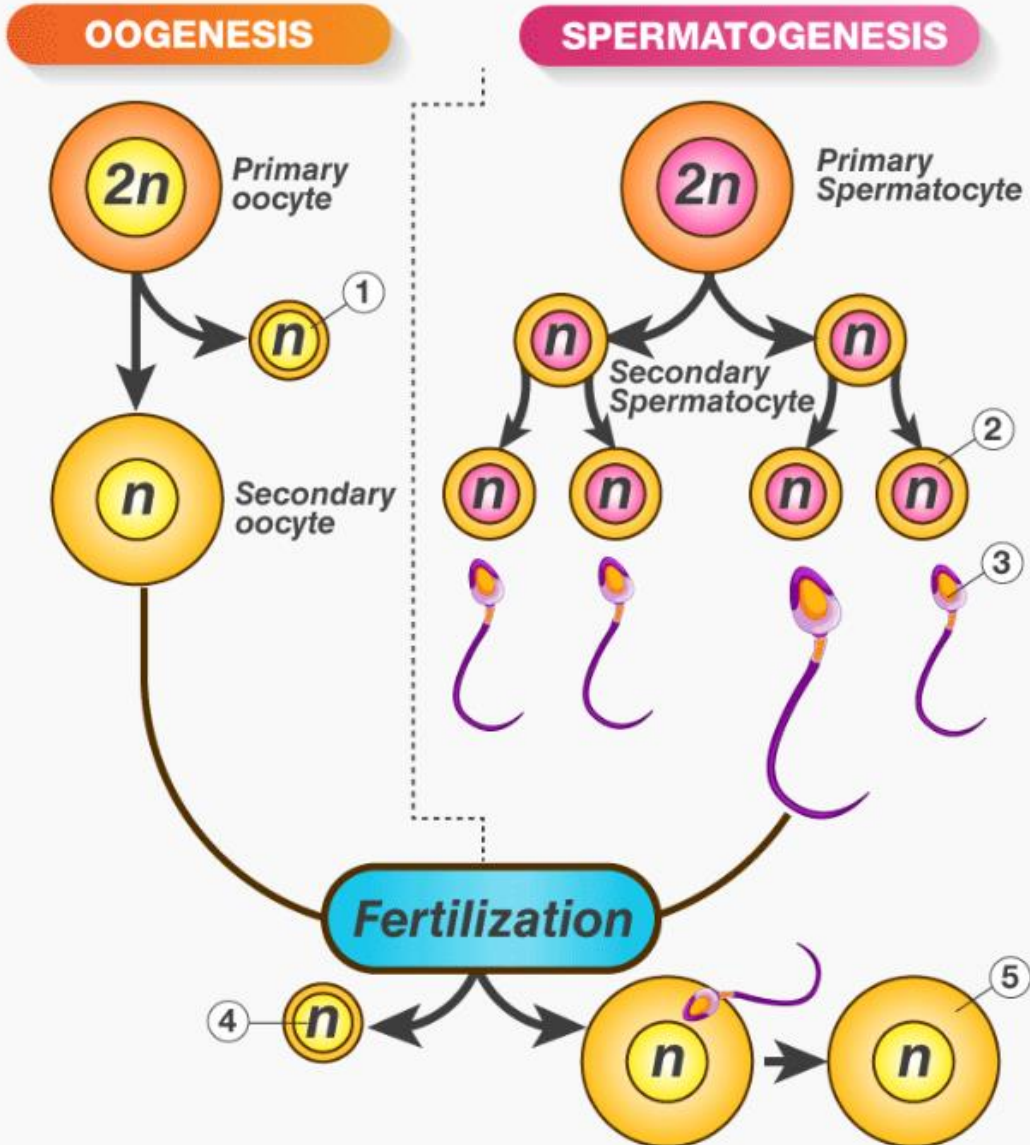
EMBRYO:

The developing human individual from the time of implantation to the end of the eighth week after conception

FETUS: A developing human from usually two months after conception to birth



SPERMATOGENESIS Vs OOGENESIS



Gametogenesis is the process of division of diploid cells to produce new haploid cells. In humans, two different types of gametes are present. Male gametes are called sperm and female gametes are called the ovum.

Spermatogenesis: Sperm formation

Oogenesis: Ovum formation

spermatocyte: a male gametocyte, from which a spermatozoon develops

oocyte: a cell that develops into an egg or ovum; a female gametocyte

polar body: one of the small cells that are by-products of the meiosis that forms an egg

mitosis: the division of a cell nucleus in which the genome is copied and separated into two identical halves. It is normally followed by cell division

meiosis: cell division of a diploid cell into four haploid cells, which develop to produce gametes

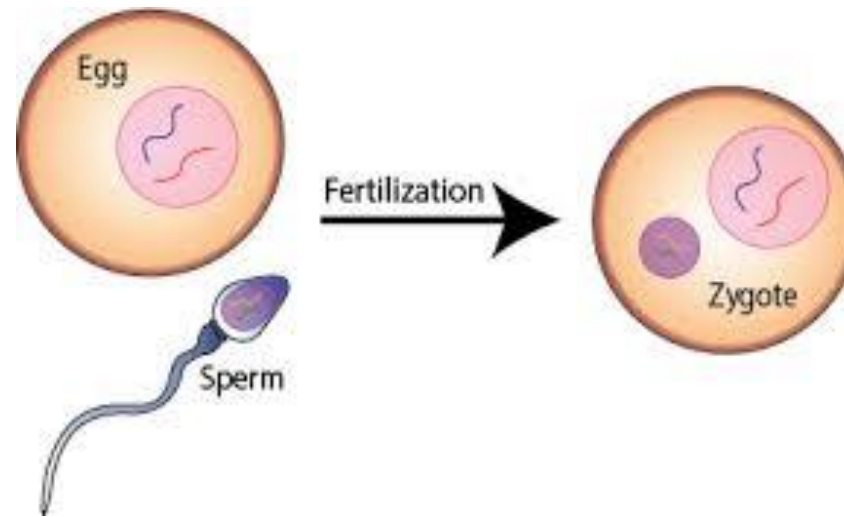
1 First polar body | 2 Spermatid | 3 Sperm | 4 Second polar body

5 Zygote

Spermatogenesis	Oogenesis
The production of sperms from spermatogonia is known as spermatogenesis	The production of eggs from oogonia is known as oogenesis
Occurs in testes	Occurs inside the ovary
All stages are completed in testes	The major part of oogenesis occurs inside the ovary. The last few stages occur in the oviduct.
It is a continuous process	It is a discontinuous process. The early stages take place in the foetus and the rest in later stages of life.
Produces motile gametes	Produces non-motile gametes
Equal cytokinesis occurs during the spermatogenesis producing four sperms	Unequal cytokinesis occurs during oogenesis ultimately producing one large ovum and tiny polar bodies

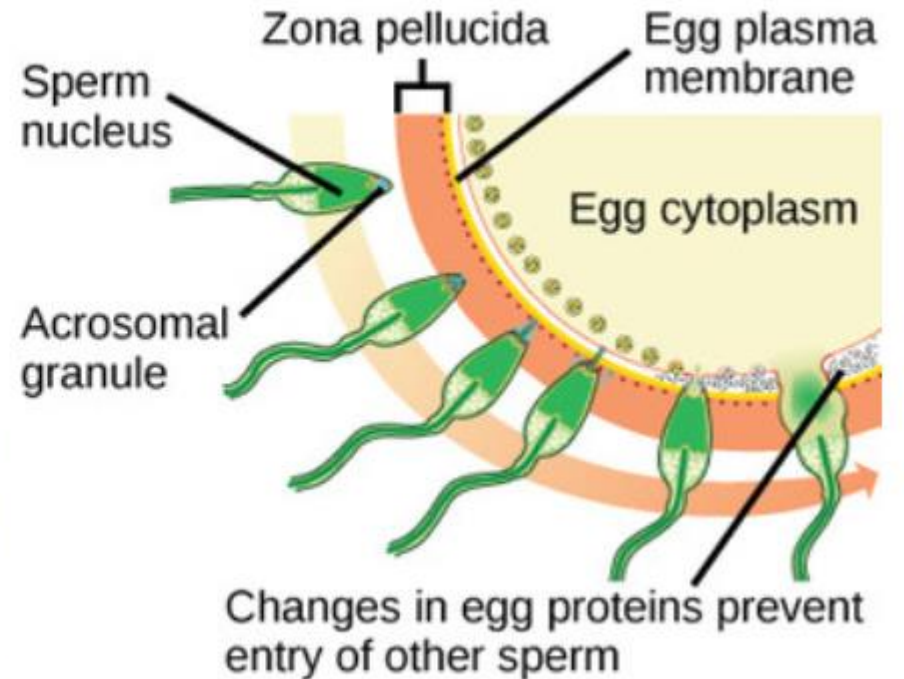
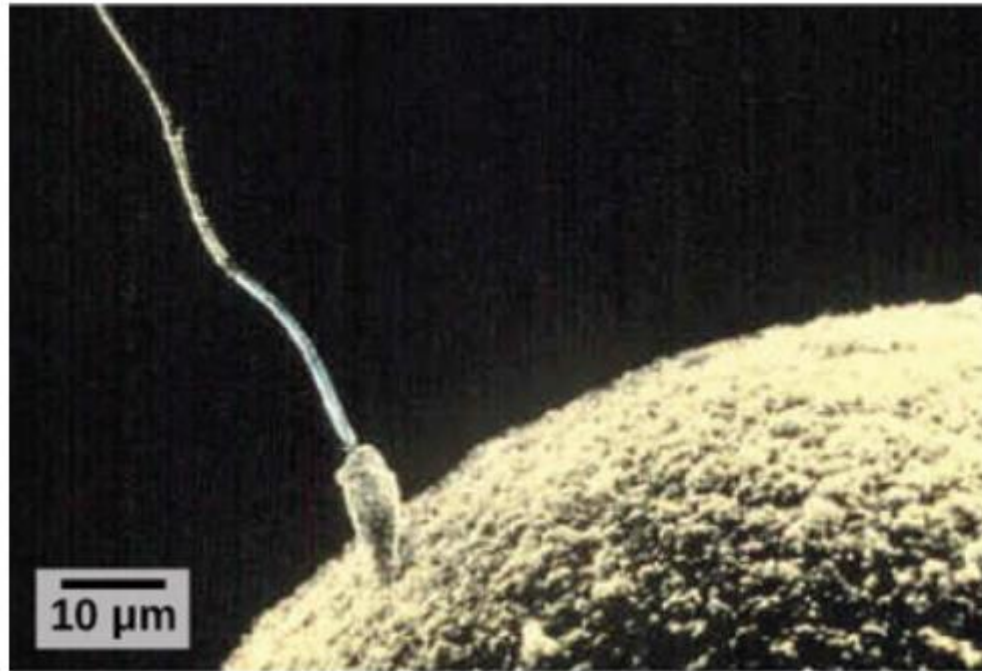
Fertilization

- 1 | Egg growth
- 2 | Ovulation
- 3 | Gamete transport
- 4 | Fertilization



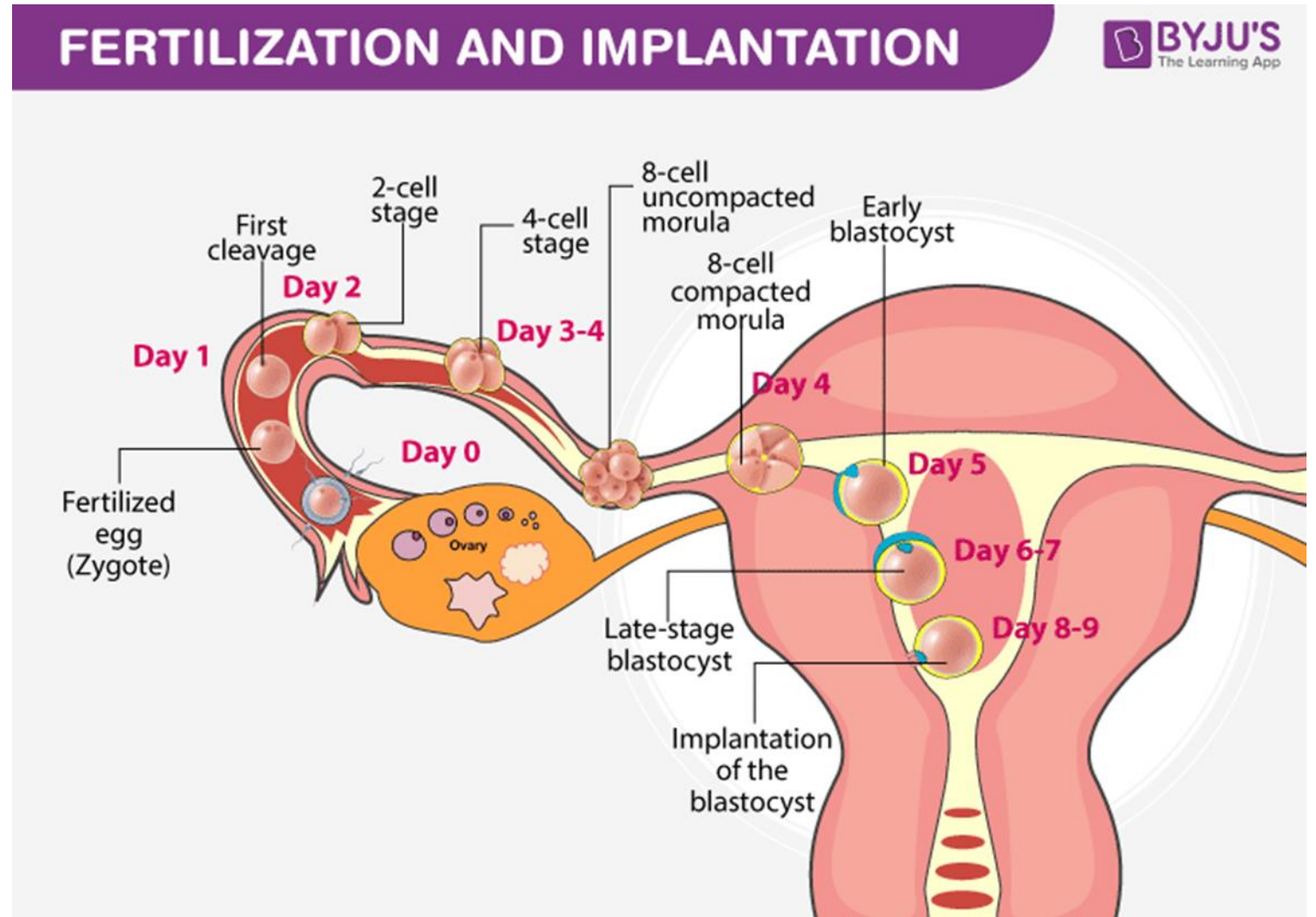
Key Terms

- fertilization**: It is the process during which a male gamete (sperm) unites with a female gamete (oocyte) to form a single cell (ZYGOTE).
- zona pellucida**: a glycoprotein membrane surrounding the plasma membrane of an oocyte
- acrosome**: a structure forming the end of the head of a spermatozoon
- polyspermy**: the penetration of an ovum by more than one sperm (THIS IS PATHOLOGICAL)



What are the different phases of fertilization?

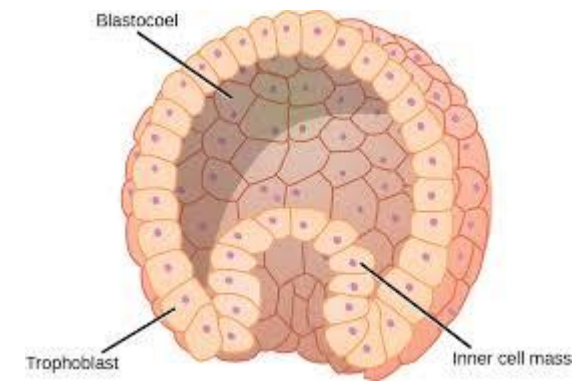
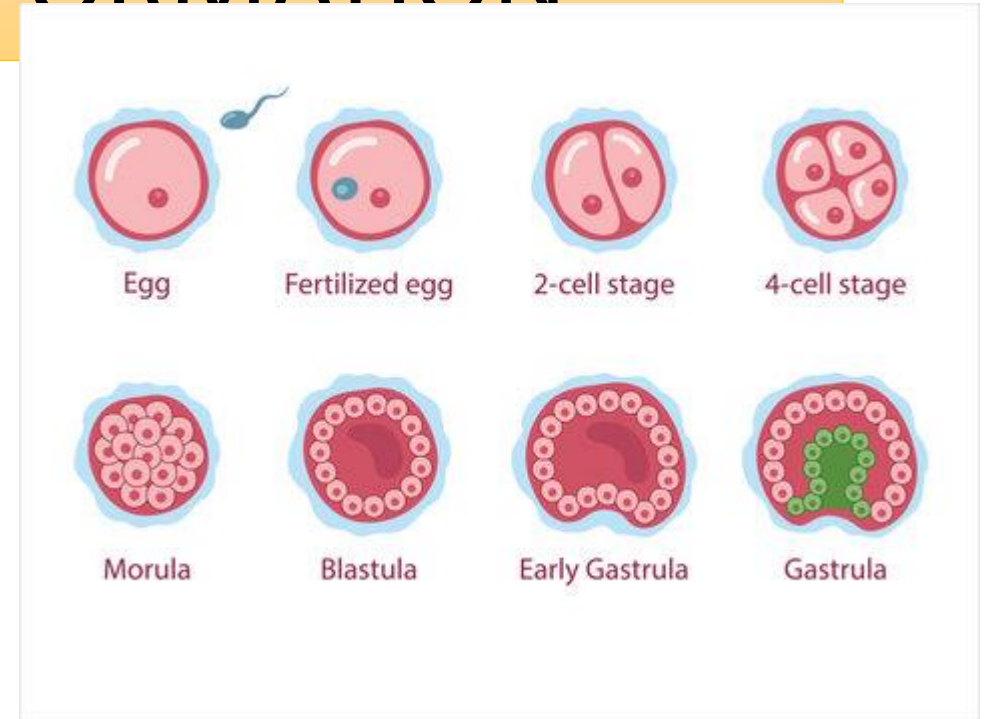
1. **PENETRATION**, where the sperm releases acrosomal enzymes to penetrate inside the egg.
2. **ACTIVATION**, where the egg membrane depolarizes.
3. **FUSION** of nuclei and formation of zygote.



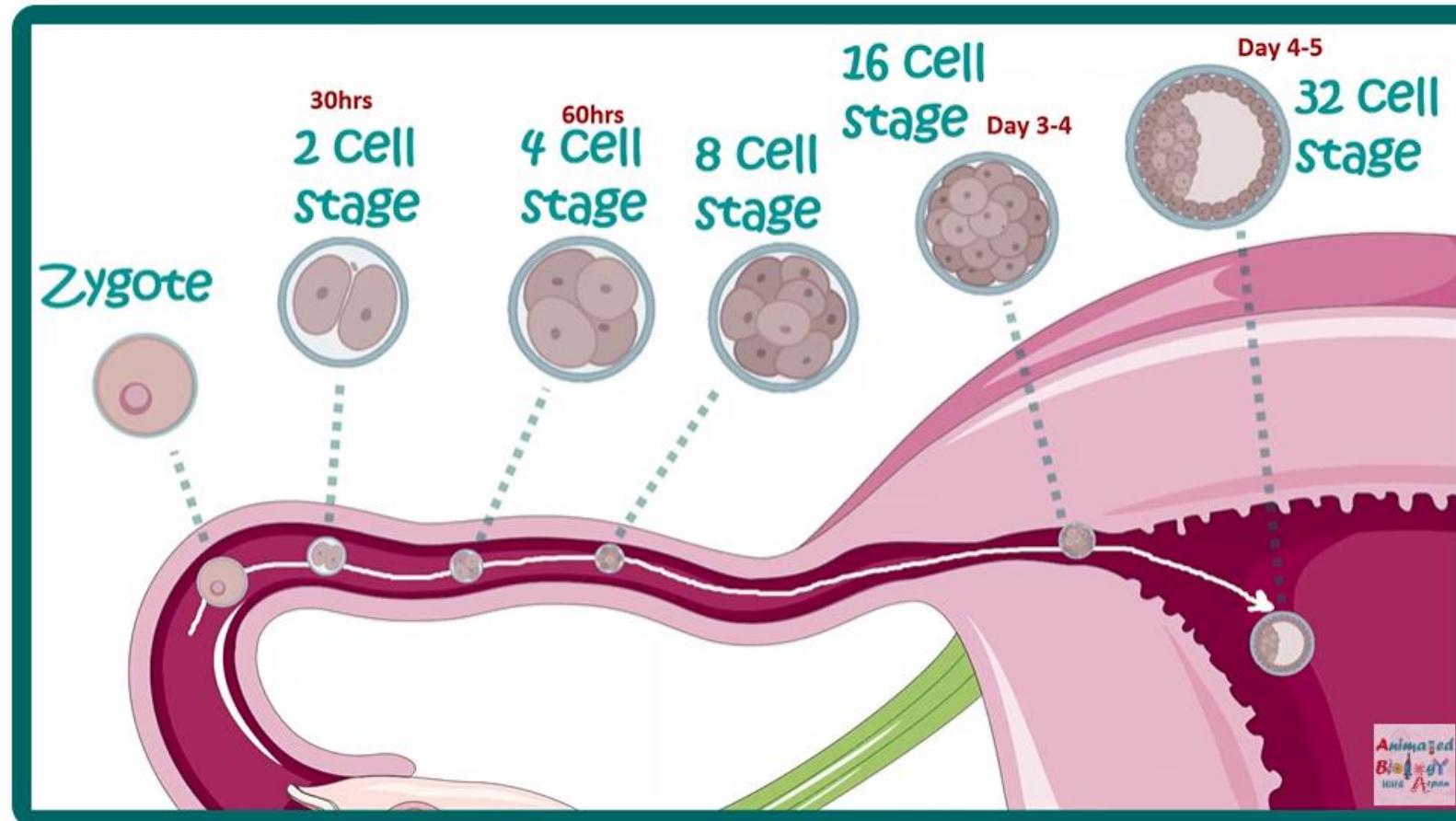
CLEAVAGE and BLAST CYST FORMATION

Key Terms

- **blastomere:** any cell that results from division of a fertilized egg
- **blastula:** a 6-32-celled hollow structure that is formed after a zygote undergoes cell division
- **meroblastic:** undergoing only partial cleavage
- **holoblastic:** cleaving, and separating into separate blastomeres
- **inner cell mass:** a mass of cells within a primordial embryo that will eventually develop into the distinct form of a fetus in most eutherian mammals
- **gastrulation:** the stage of embryo development at which a gastrula is formed from the blastula by the inward migration of cells
- **trophoblast:** the membrane of cells that forms the wall of a blastocyst during early pregnancy, providing nutrients to the embryo and later developing into part of the placenta



CLEAVAGE and BLAST CYST FORMATION



CLEAVAGE and BLAST CYST FORMATION

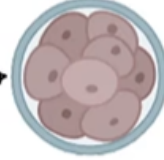
2 Cell
stage



4 Cell
stage



8 Cell
stage



Cell size doesn't change
Cell number has increased

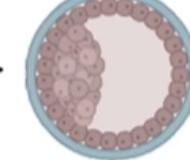
16 Cell
stage



Morula
Day 4

Zona pellucida
still remains

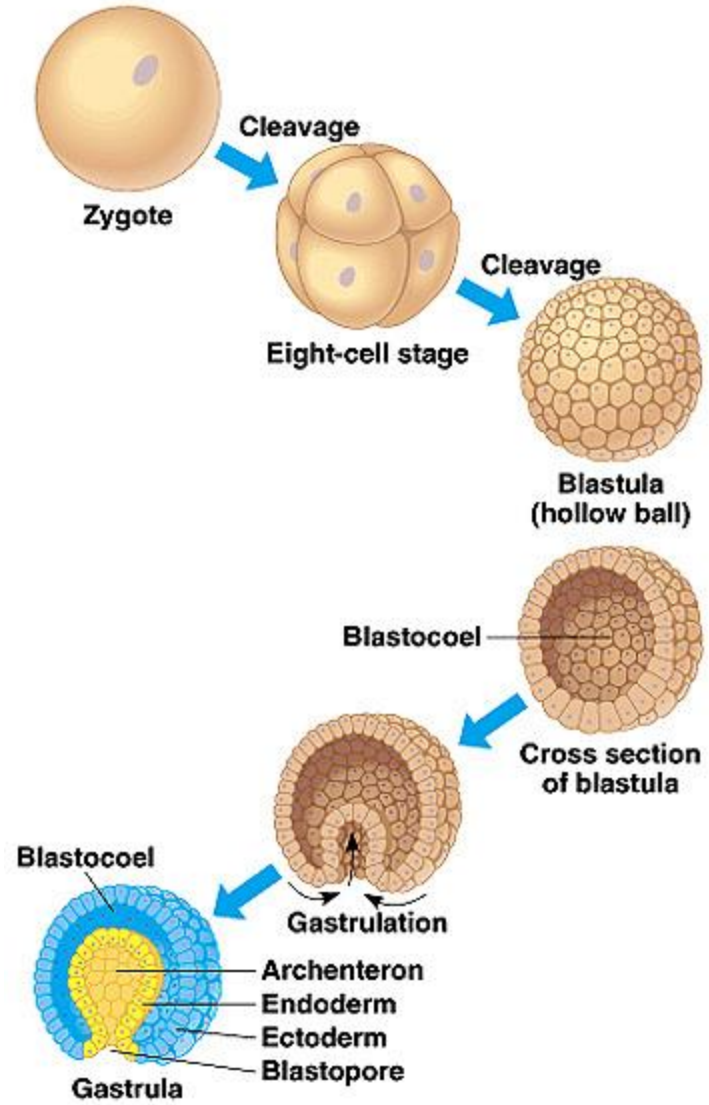
32 Cell
stage



Blastocyst

Gastrulation

- 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.
- During gastrulation, the blastula folds upon itself to form the three layers of cells.
- Each of these layers is called a germ layer, which differentiate into different organ systems.



Differentiation of germ layers

- The three germ layers give rise to different cell types in the animal body:

✓ **the ectoderm** forms:

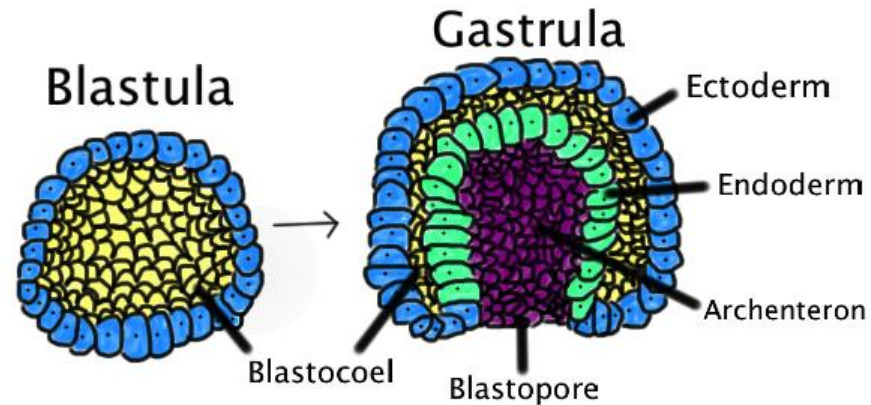
1. the nervous system
2. the outer layer of skin

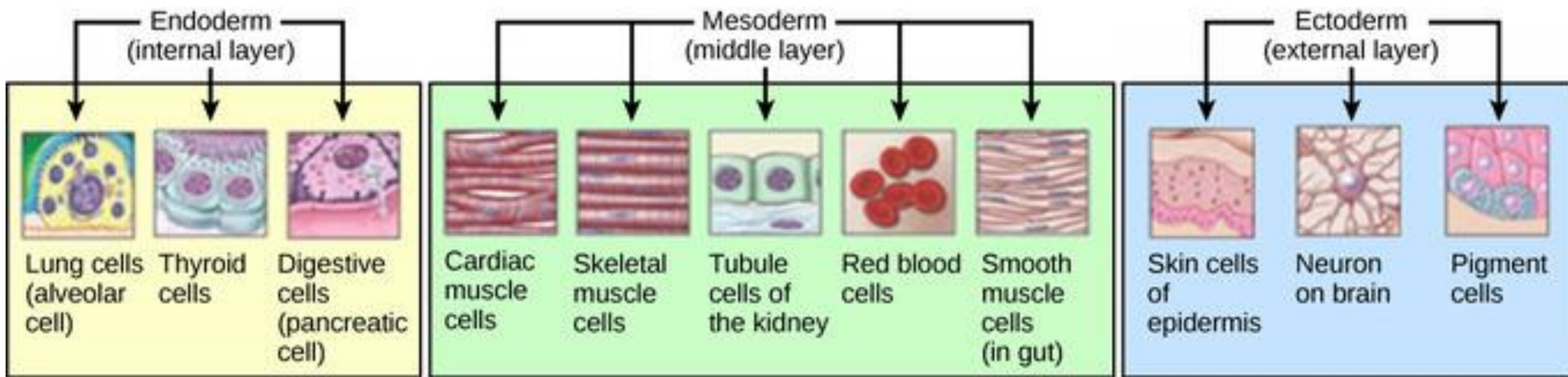
✓ **the mesoderm** gives rise to:

1. muscles
2. connective tissues,

✓ **the endoderm** gives rise to the:

- columnar cells found in the digestive system and many internal organs.





Endoderm
(internal layer)



Lung cells
(alveolar cell)

Thyroid cells

Digestive cells
(pancreatic cell)

Mesoderm
(middle layer)



Cardiac muscle cells

Skeletal muscle cells

Tubule cells of the kidney

Red blood cells

Smooth muscle cells
(in gut)

Ectoderm
(external layer)



Skin cells of epidermis

Neuron on brain

Pigment cells



بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

﴿ هَلْ أَتَى عَلَى الْإِنْسَانِ حِينٌ مِّنَ الدَّهْرِ لَمْ يَكُن
شَيْئًا مَّذْكُورًا ﴾ ﴿ إِنَّا خَلَقْنَا الْإِنْسَانَ مِنْ نُطْقَةٍ أَمْشَاجٍ
نَّبْتَلِيهِ فَجَعَلْنَاهُ سَمِيعًا بَصِيرًا ﴾