

Aim: What happens after fertilization?

- **Do Now:** Describe the process of fertilization.
- A sperm enters an ovum, and the nuclei combine to form one with 46 chromosomes.

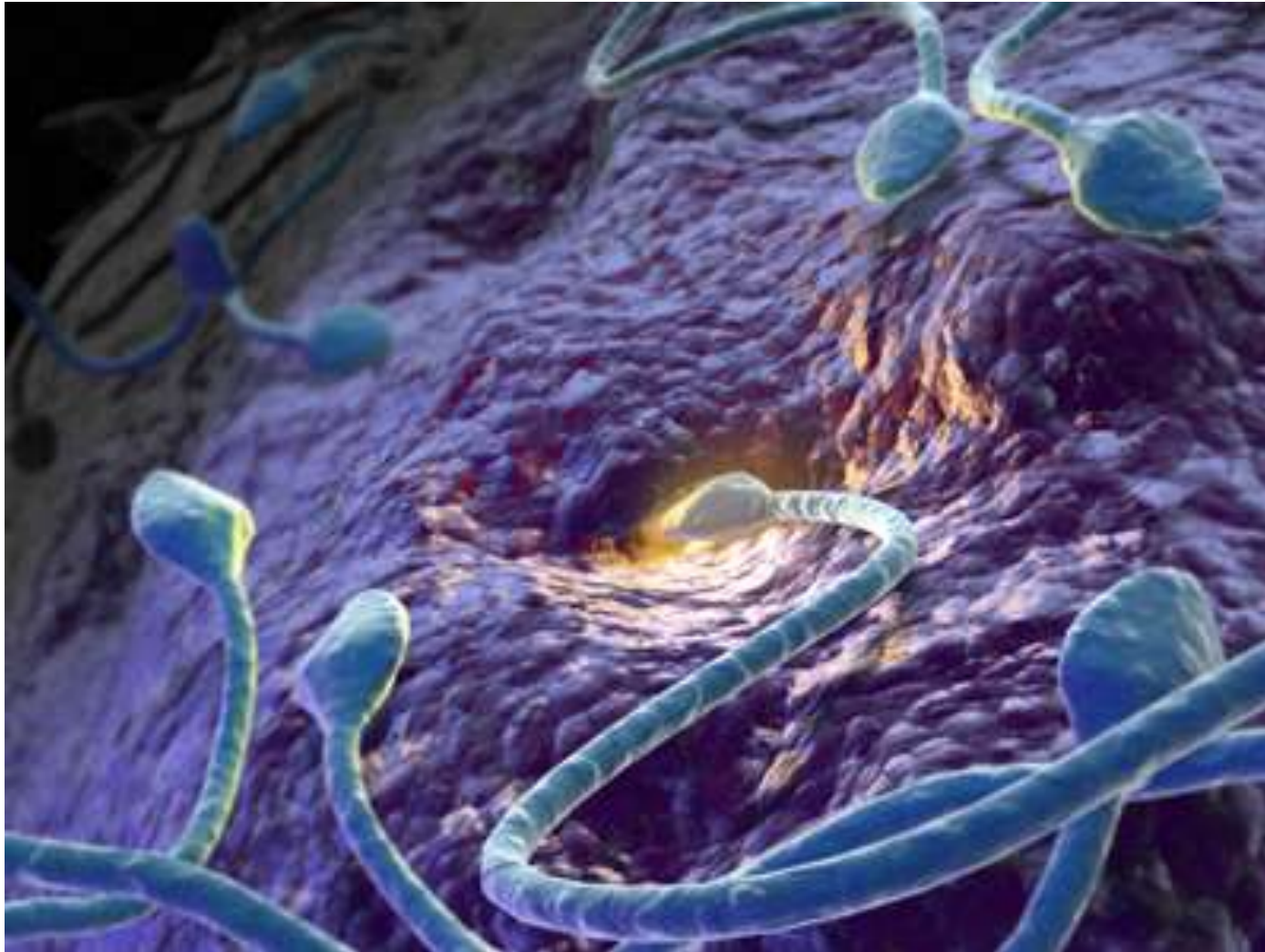
Fertilization: Four Major Steps

1. Sperm contacts the egg
2. Sperm or its nucleus enters the egg
3. Egg becomes activated and developmental changes begin
4. Sperm and egg nuclei fuse

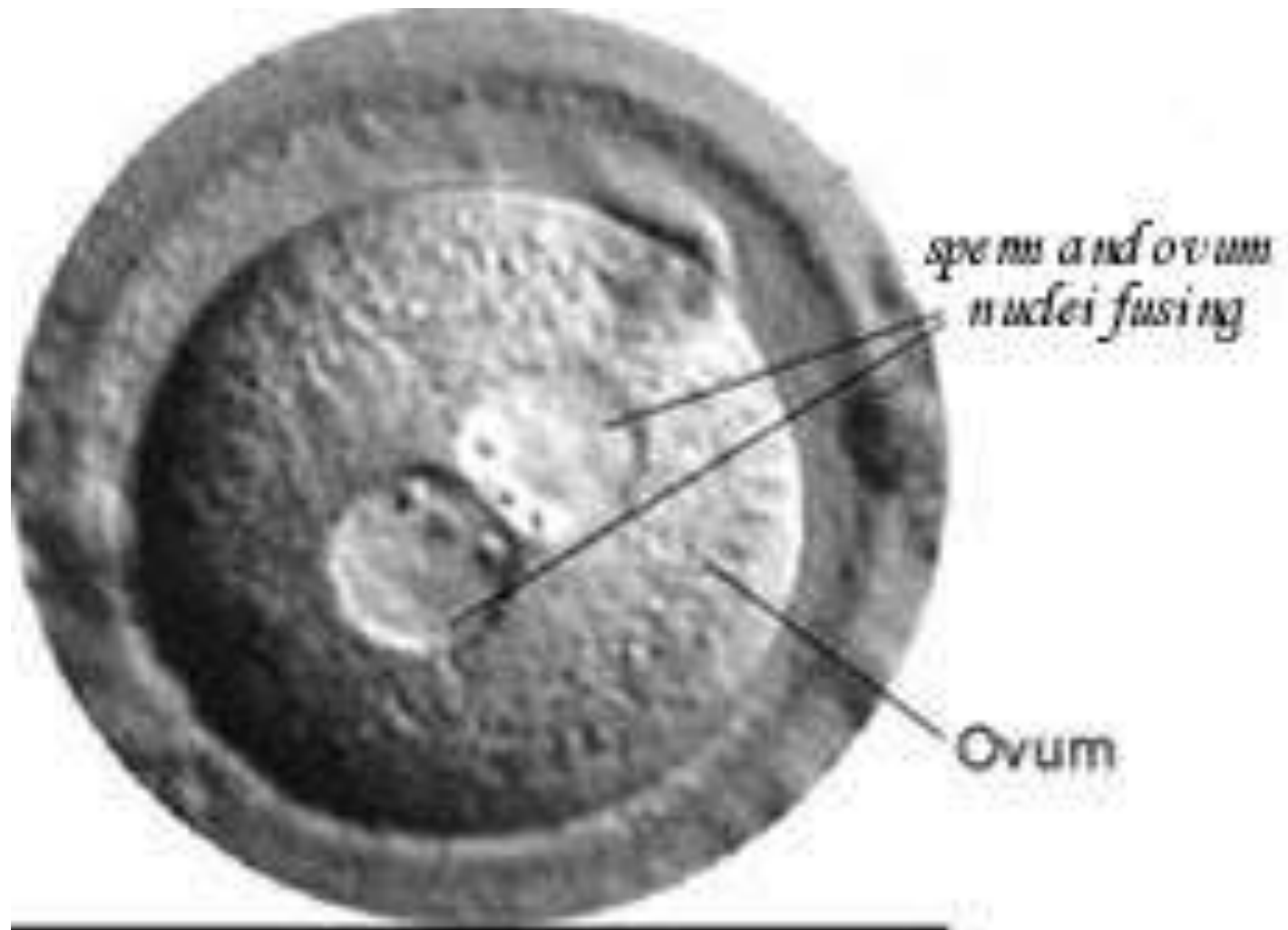
Words to know...

- **Fuse-** to physically join together
- **Ovum** – egg cell (female gamete)
- **Cleavage** – process of cell division during development
- **Differentiation** – the process of forming different kinds of cells from similar cells of the early embryo
- **Embryo** – an organism in an early stage of development
- **Morula** – solid ball of cells formed from cleavage

Fertilization



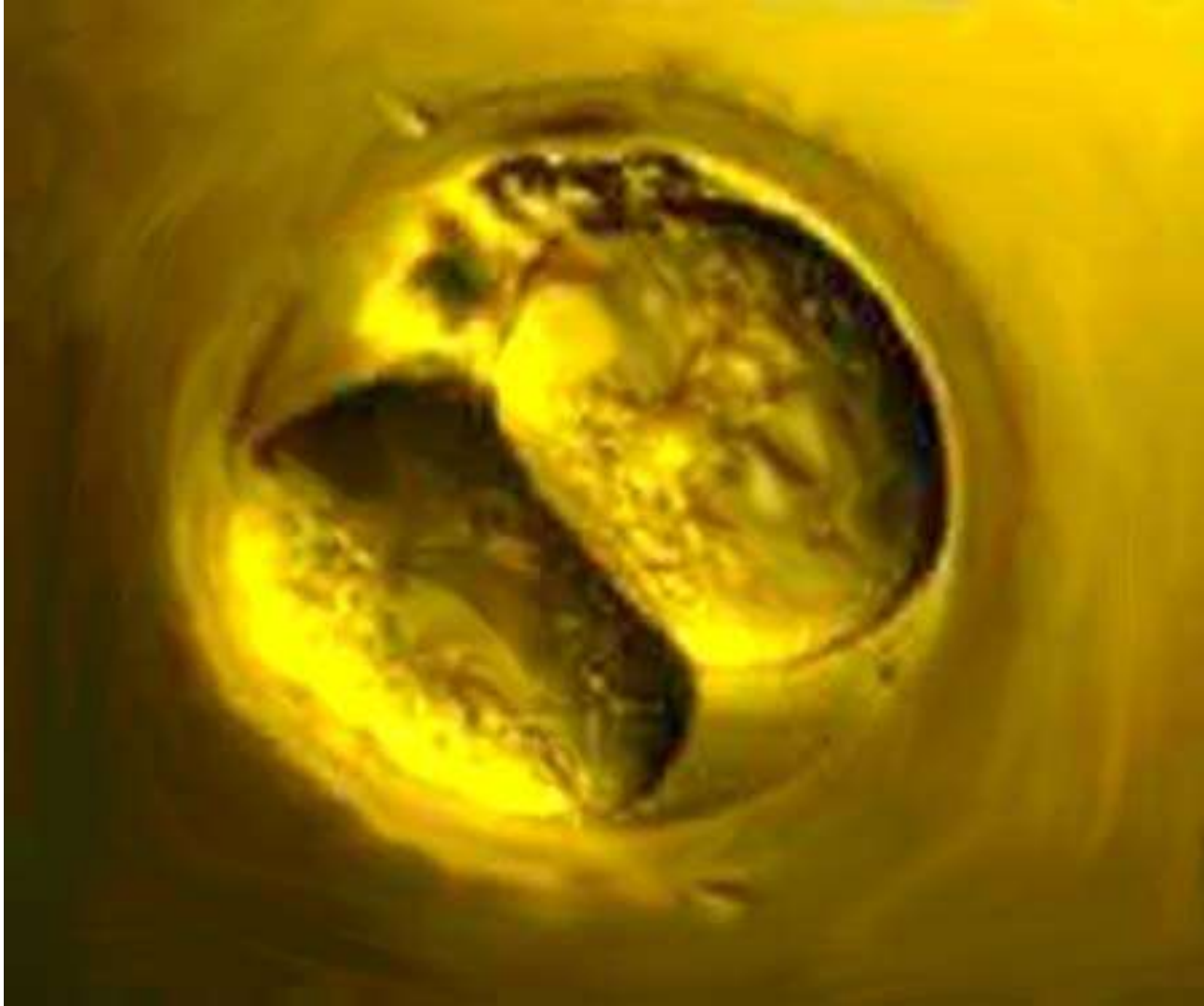
The Nuclei Fuse Together



What happens now?

- Development of the zygote, the study of which is known as ***embryology*** or ***developmental biology***.
- The zygote undergoes a series of mitotic cell divisions called ***cleavage***.
- The stages of development are:

Cleavage (divide via mitosis)
forms the 2 cell stage



They split again to form the 4 cell stage



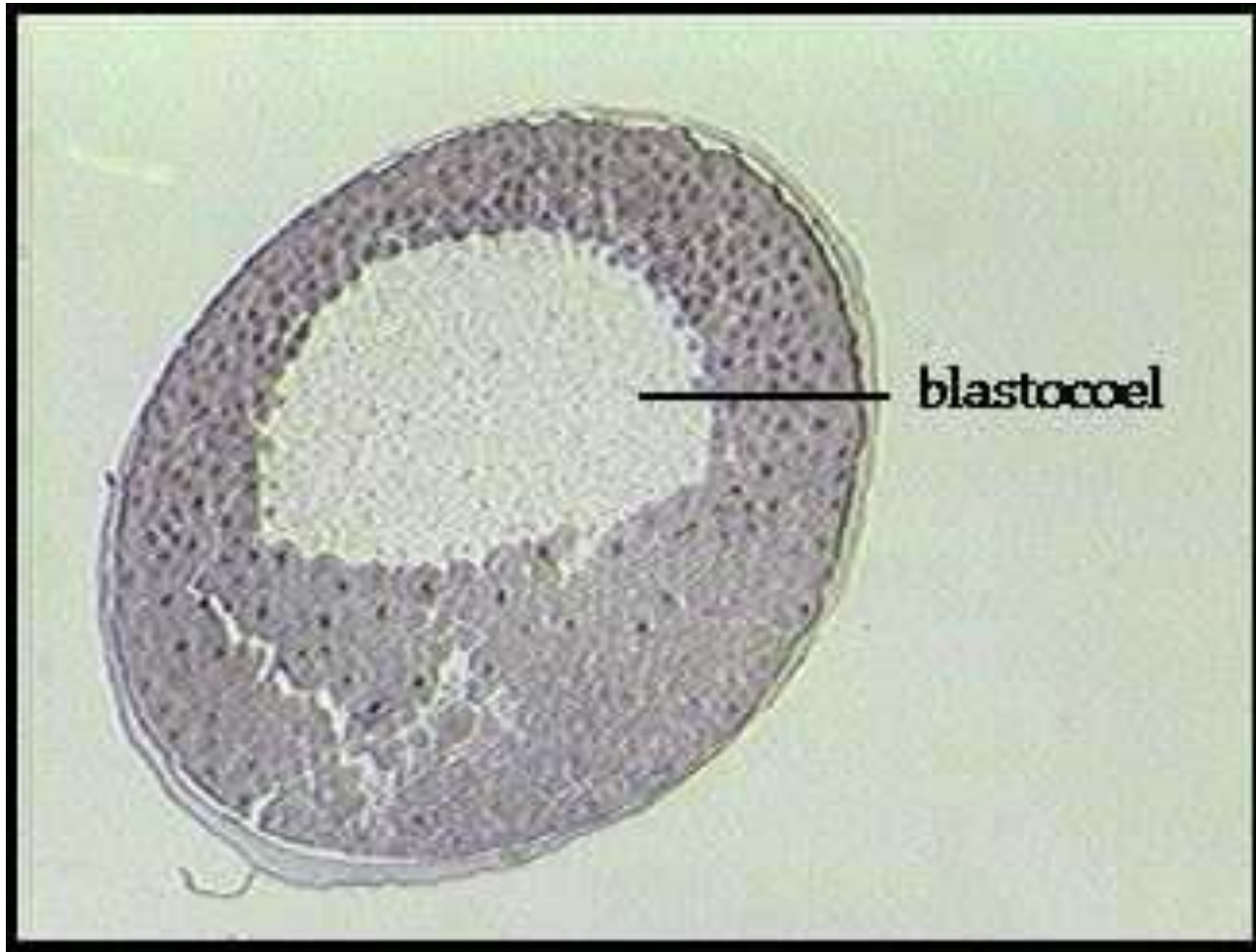
And again to form the 8 cell stage...



And eventually form a Morula



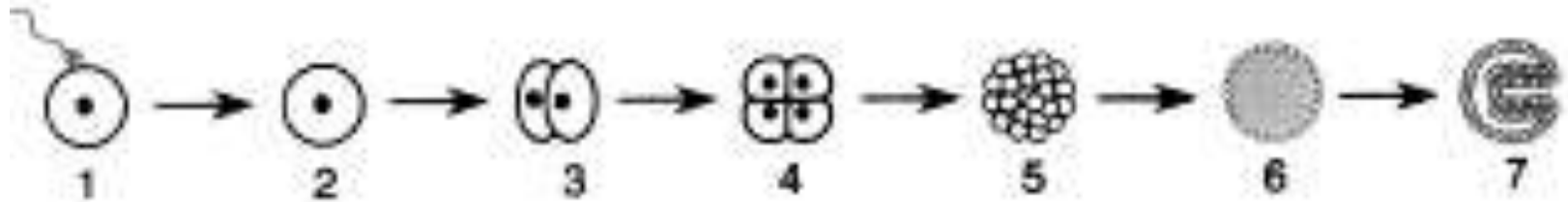
Next it becomes a blastula



And next, a gastrula



The Regents Diagram...



1. Sperm and ovum
2. Zygote (fertilized ovum)
3. 2-cell stage
4. 4-cell stage
5. Morula
6. Blastula
7. Gastrula

Aim: What happens after cleavage begins?

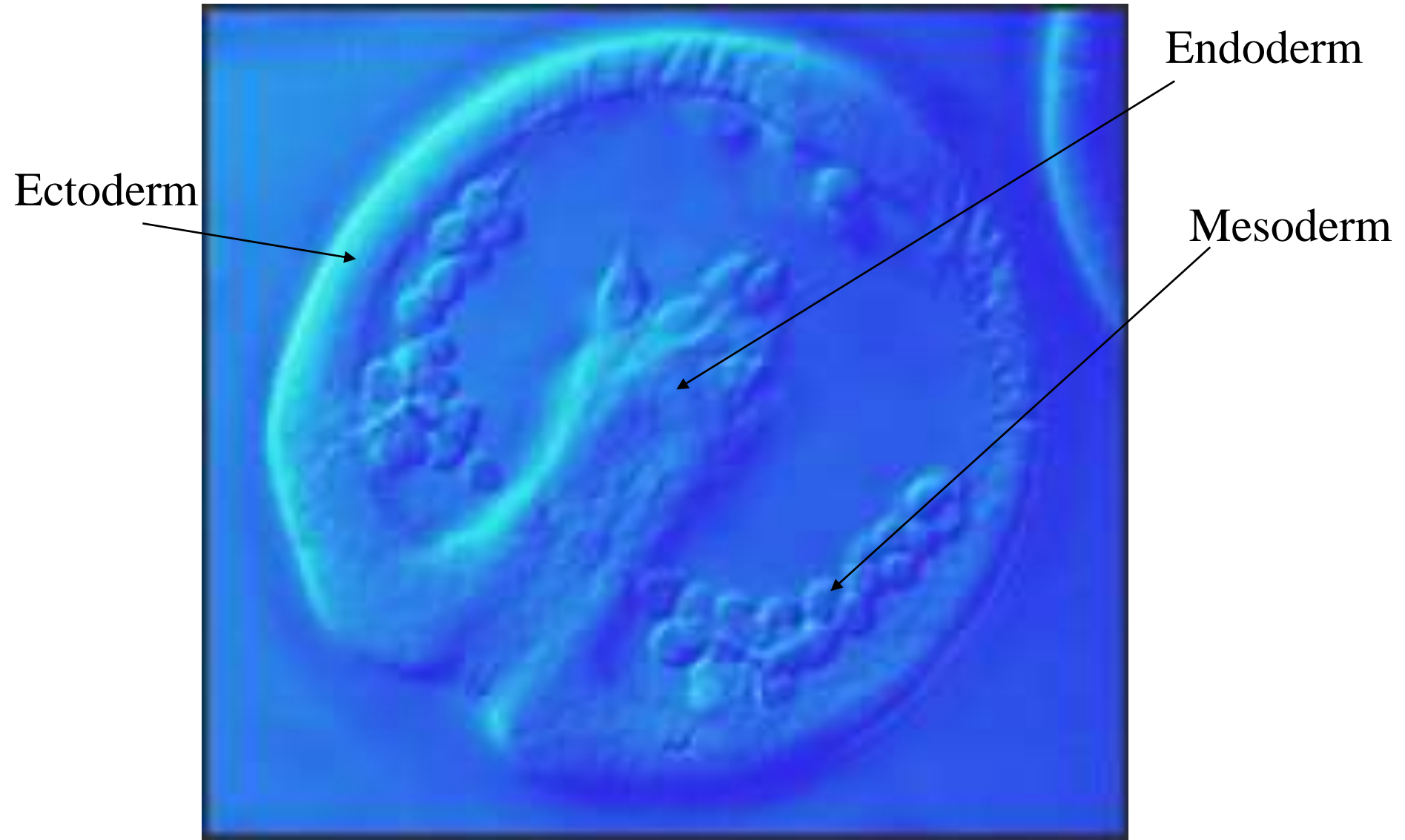
- Do now: How does a single celled zygote become a gastrula?

Differentiation

(Organogenesis)

- *Organogenesis* is the formation of the organs (Organo = organs, genesis = creation)
- Arises from the layering of cells that occurs during gastrula stage
- The layers are *germ layers*; they have specific fates in the developing embryo:
 - *Endoderm*
 - The innermost layer
 - Goes on to form the gut
 - *Mesoderm*
 - In the middle
 - Goes on to form the muscles, circulatory system, blood and many different organs
 - *Ectoderm*

Late Gastrula



Differentiation of Primary Germ Layers (from the gastrula)

Ectoderm	Mesoderm	Endoderm
Nervous system	Skeleton	Digestive tract
Epidermis of skin	Muscles	Respiratory system
	Circulatory system	Liver, pancreas

Early Human Development Summary

- Meiosis makes sperm in males and ovum in females
- Sperm and ovum unite nuclei to form a zygote
- Zygote undergoes cleavage and becomes gastrula with 3 germ layers

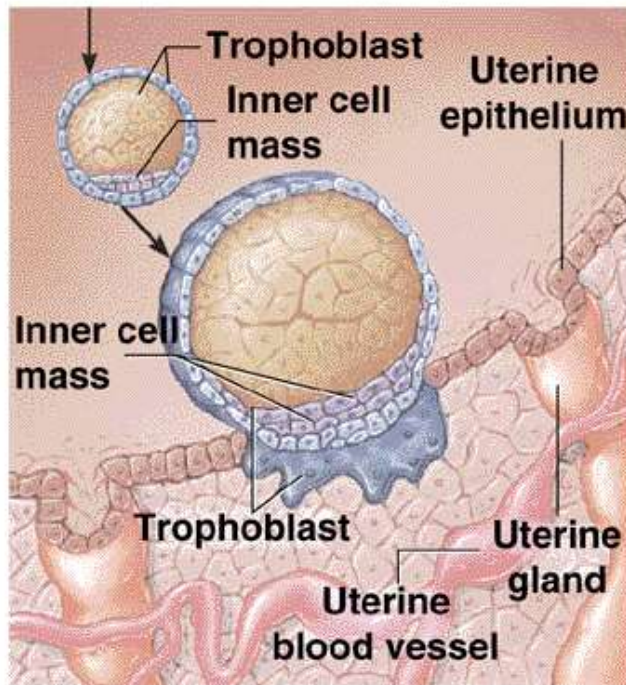
Human Prenatal Development

- Gestation lasts 266 days from fertilization to birth
- Development begins in the oviduct
 - About 24 hours after fertilization, the zygote has divided to form a 2-celled embryo
 - The embryo passes down the oviduct by cilia and peristalsis
 - The *zona pellucida* has dissolved by the 5th day, when the embryo enters the uterus
 - The embryo floats free for several days, nourished by fluids from glands in the

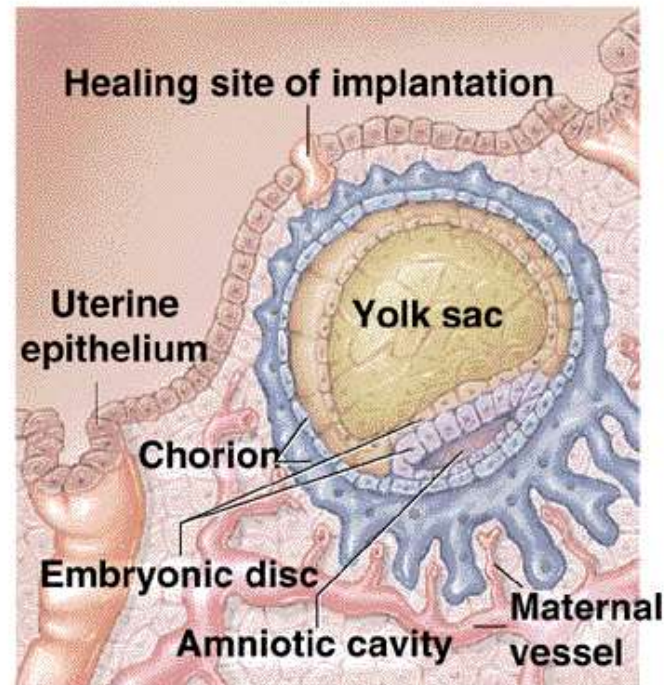
Implantation

- The embryo implants in the wall of the uterus on about the 7th day of development

Solomon/Berg/Martin, Biology, 6/e
Figure 49.16

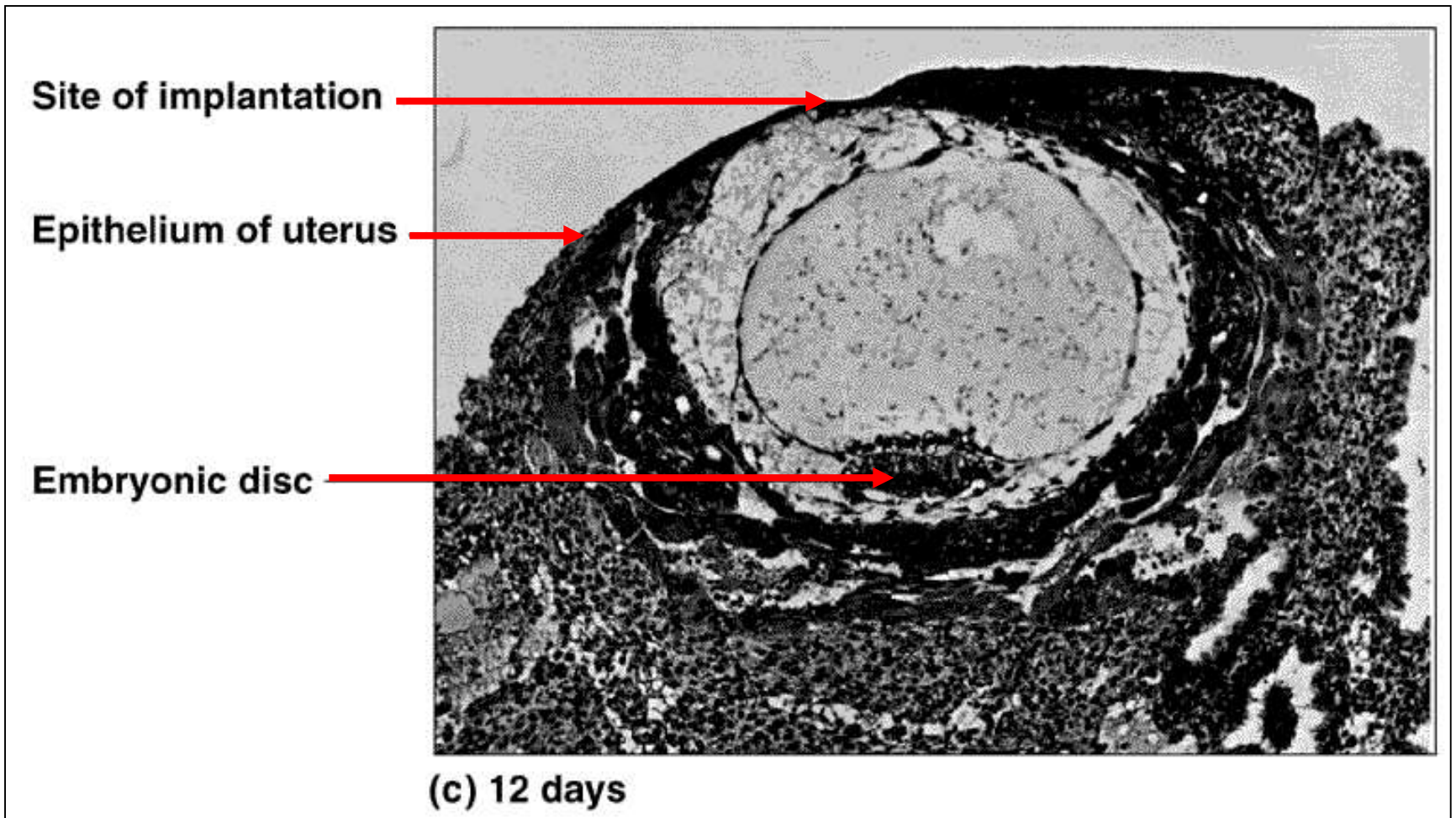


(a) 7 days

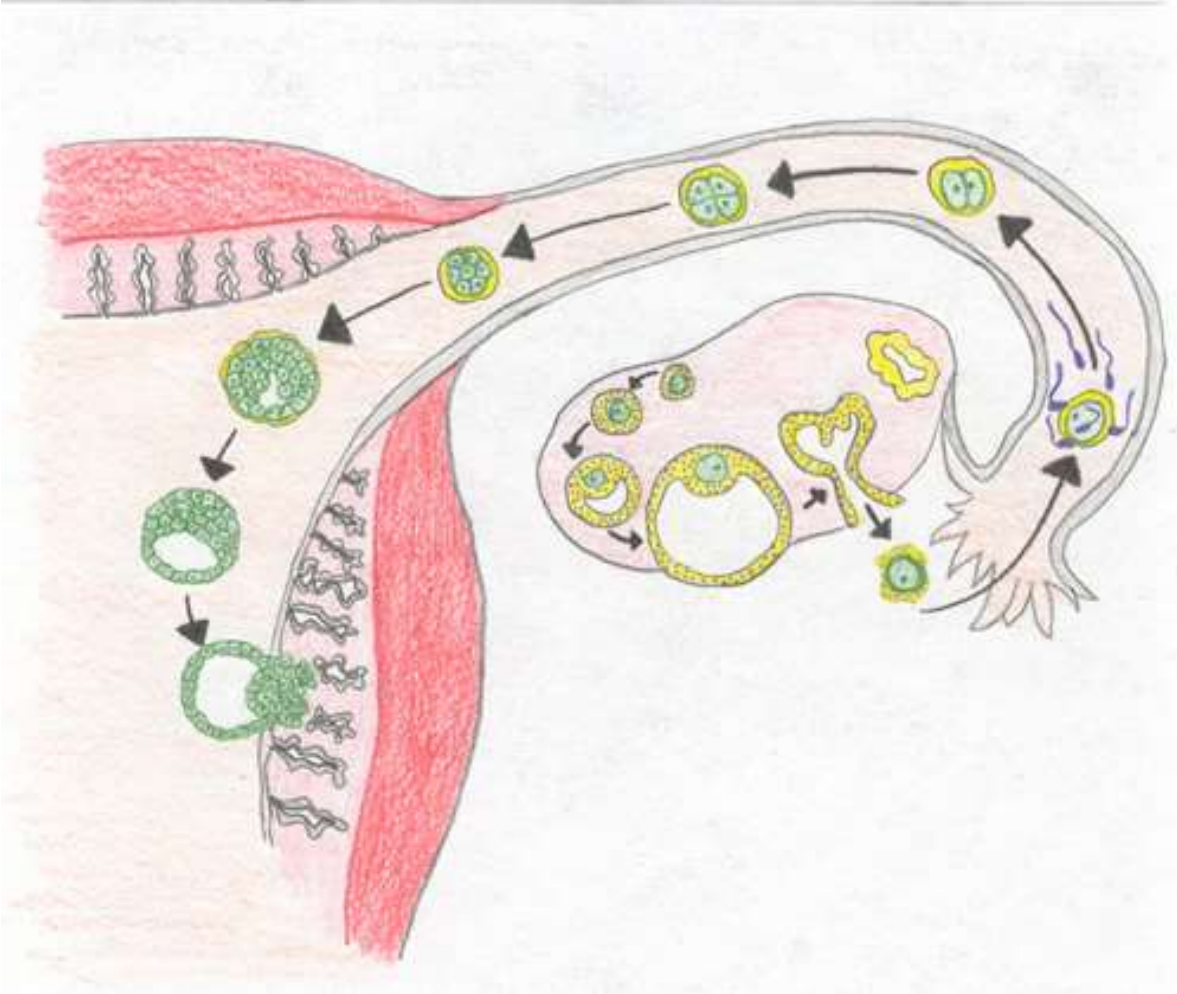


(b) 10 days

12-day Human Embryo



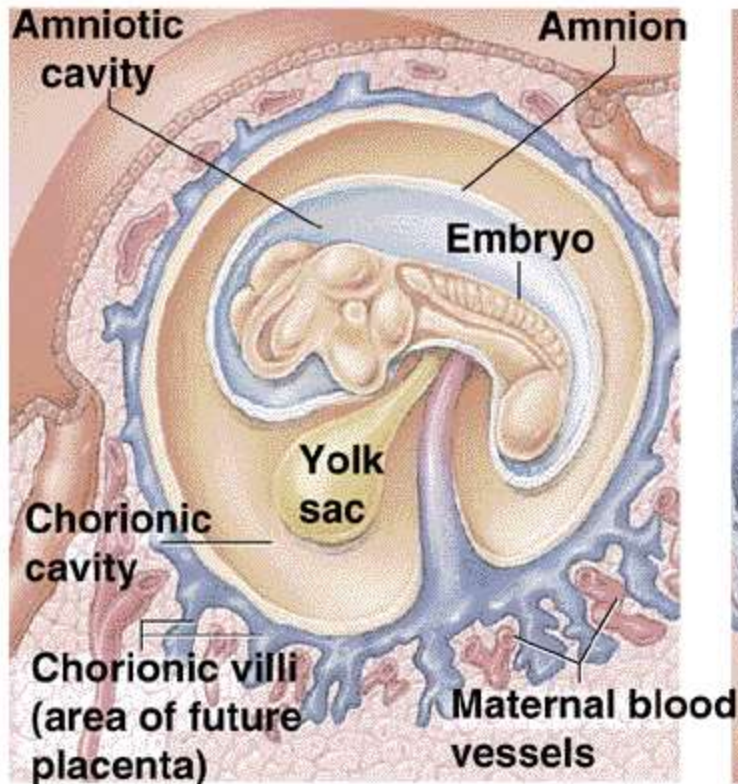
Where does this all take place?



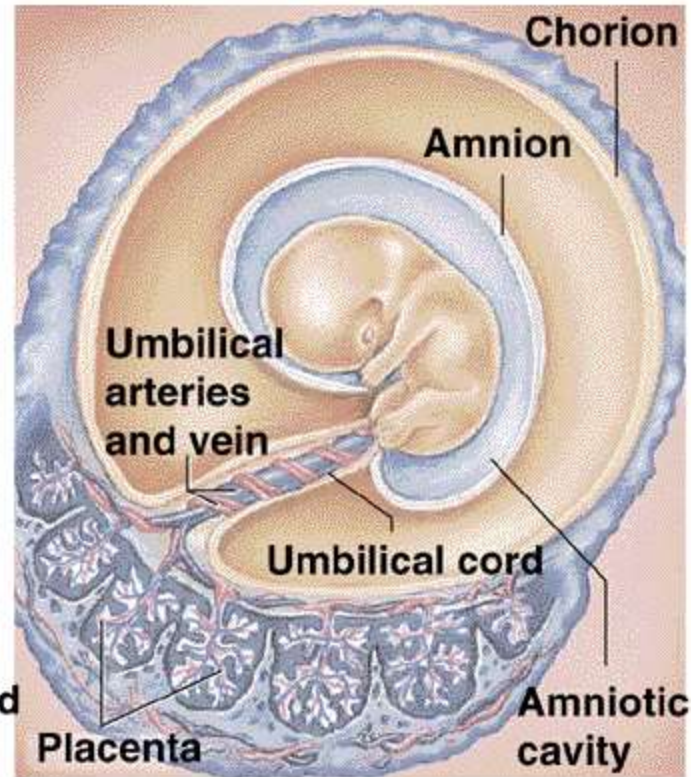
The Placenta

- The *placenta* is the site of nutrient, gas, and waste exchange
- Secretes hormones that maintain pregnancy
 - *Trophoblast* cells release *human chorionic gonadotropin* (hCG) which signals the corpus luteum to enlarge and produce progesterone
- The placenta develops from the embryonic chorion and maternal uterine tissue
- *Chorionic villi* are formed from the

Development of the Placenta

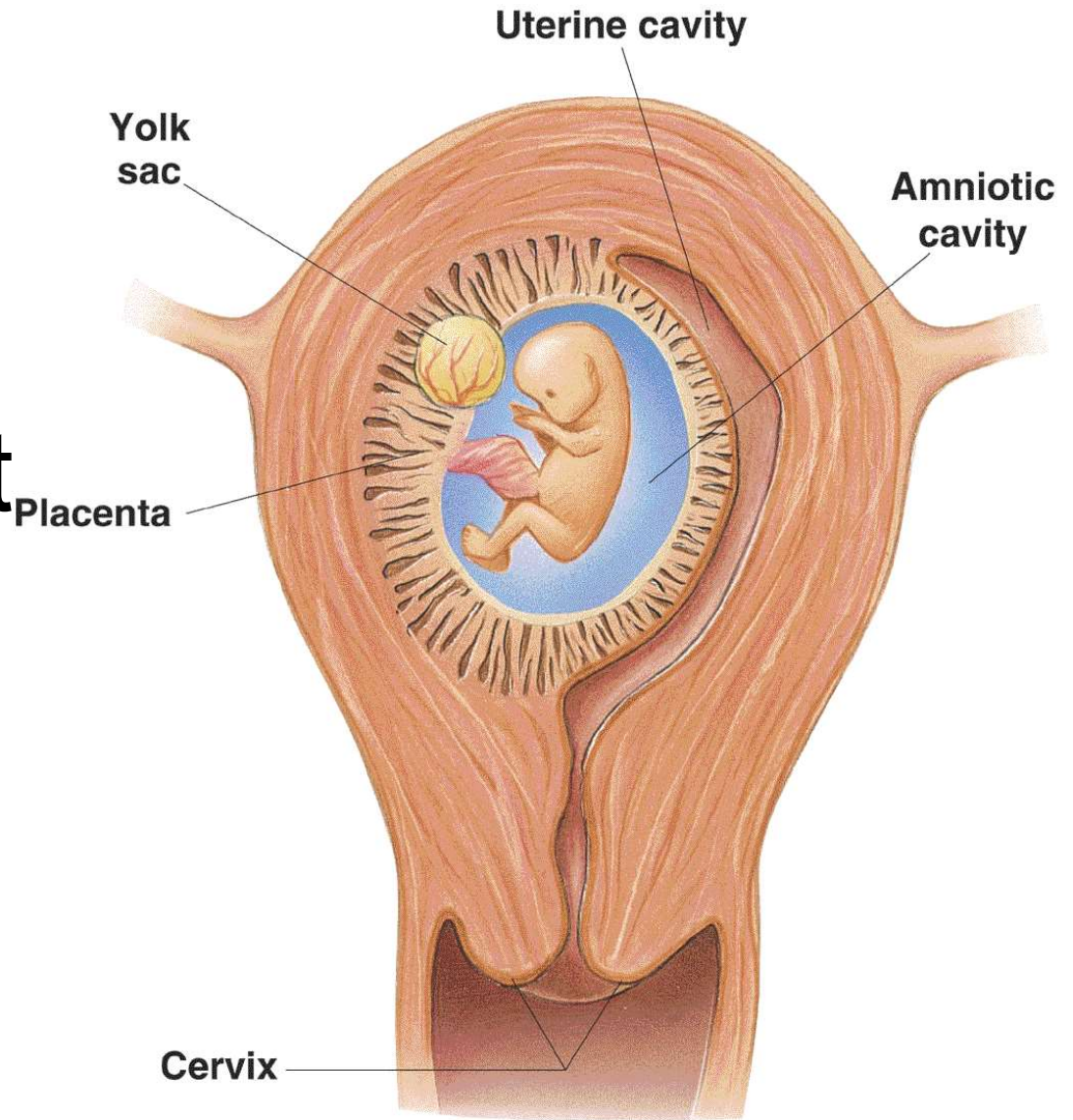


(d) 25 days



(e) 45 days

Human Fetus at Ten Weeks



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