



Fertilization to Implantation

BOOKLET 3

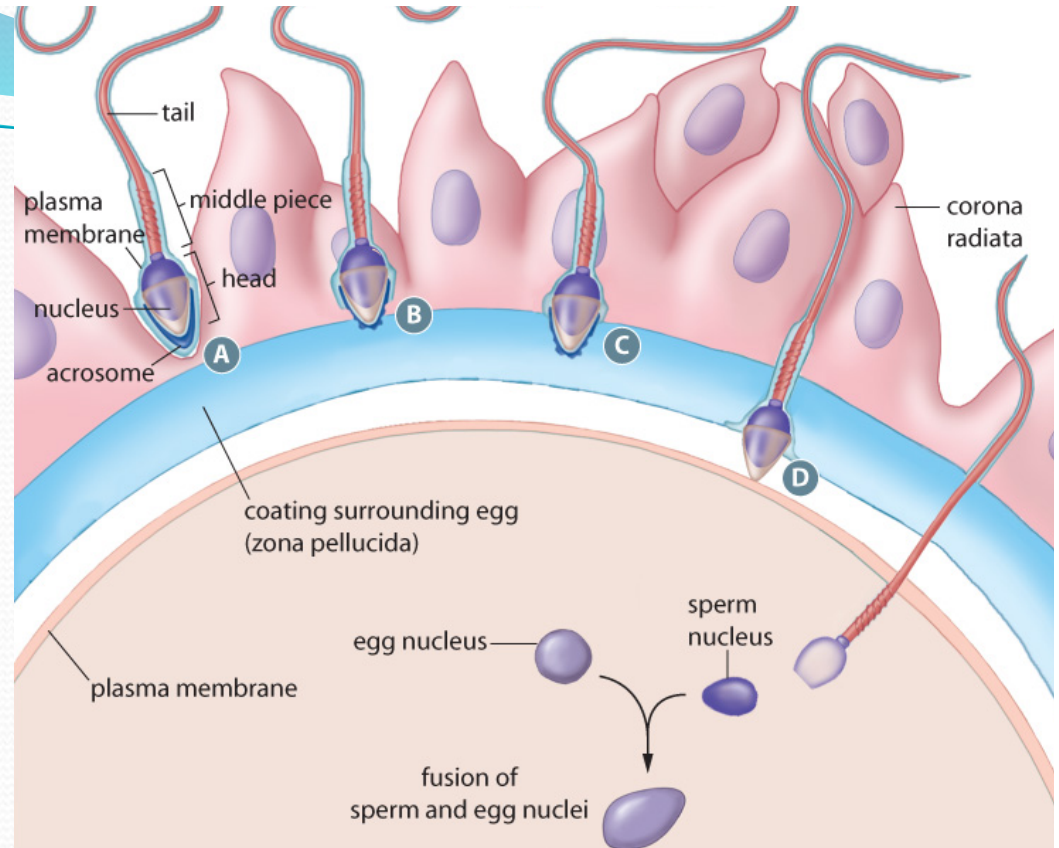
First Stages of Development

Fertilization:

Occurs: in **FALLOPIAN TUBE**
(within 24 h of ovulation)

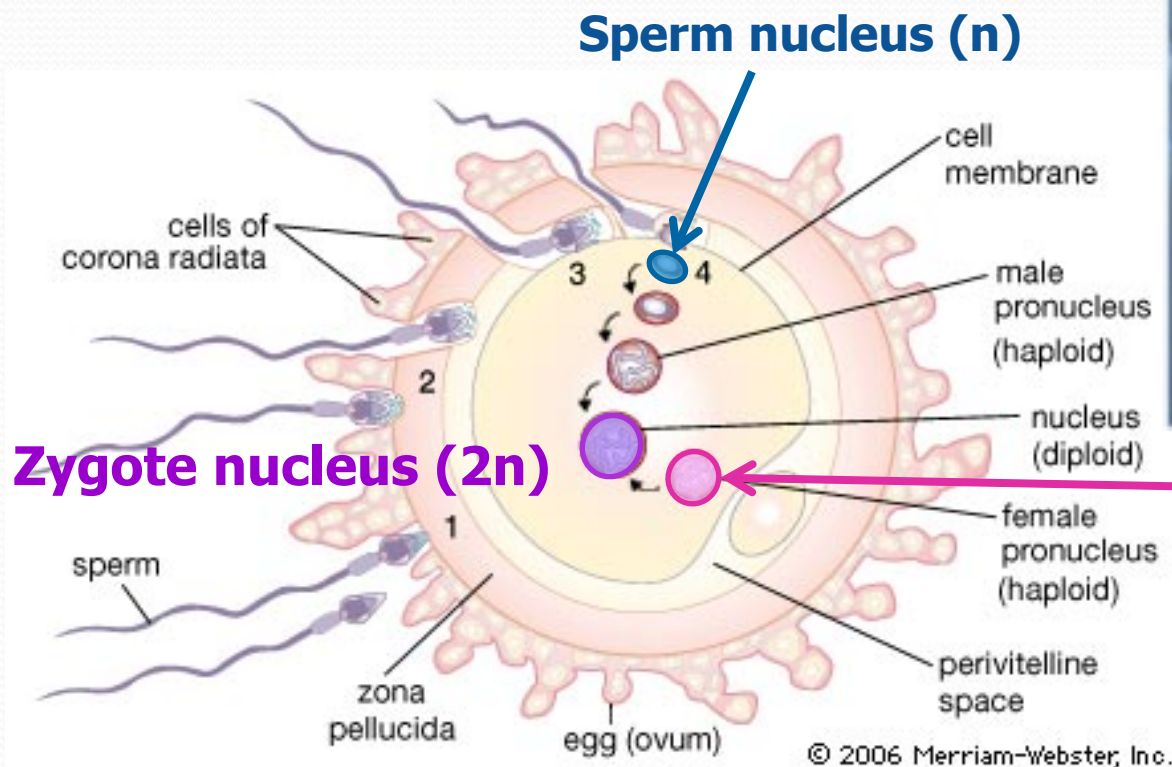
Only a few dozen of the
best swimmers make it!!

- Sperm reaches egg & uses acrosome to digest through outer layer
- Sperm travels further eventually reaching the plasma membrane of the ovum.
- One sperm enters, causing cell membrane to depolarize preventing entrance of other sperm.
- Sperm and Ovum nuclei fuse ($23+23 = 46$)



Fertilization

- **Gametes** (n) fuse to form a **zygote** ($2n$)
- Zygote = **first SINGLE cell of new life**



Egg nucleus (n)

Early Stages of Development

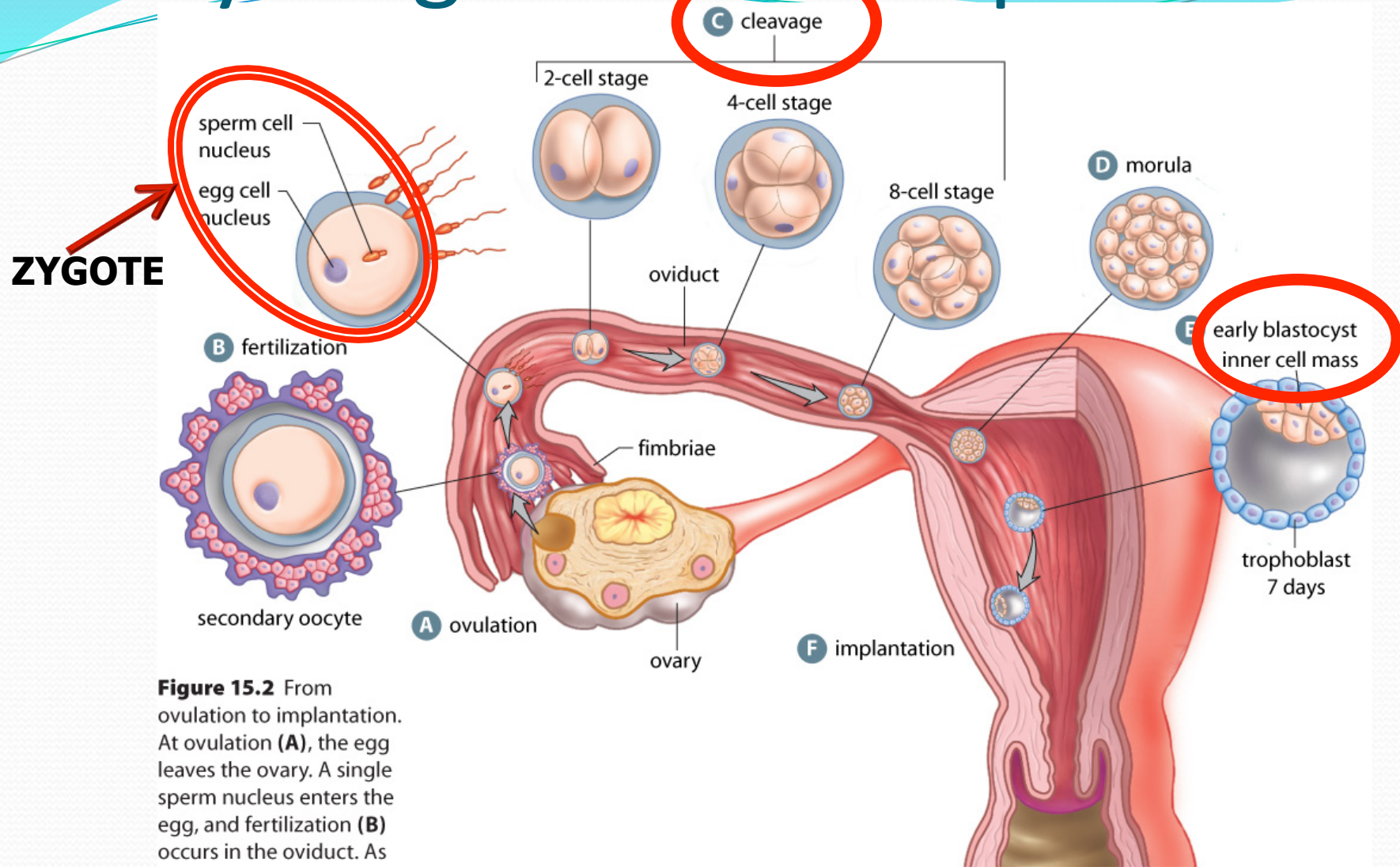


Figure 15.2 From ovulation to implantation. At ovulation (**A**), the egg leaves the ovary. A single sperm nucleus enters the egg, and fertilization (**B**) occurs in the oviduct. As the zygote moves along, it undergoes cleavage (**C**) to produce a morula (**D**). The blastocyst forms (**E**) and implants in the lining of the uterus (**F**).



When can Conception Occur?

- Ova can survive at most for approx. 2 days post ovulation while sperm can survive for up to approx. 5 days given the right environment.

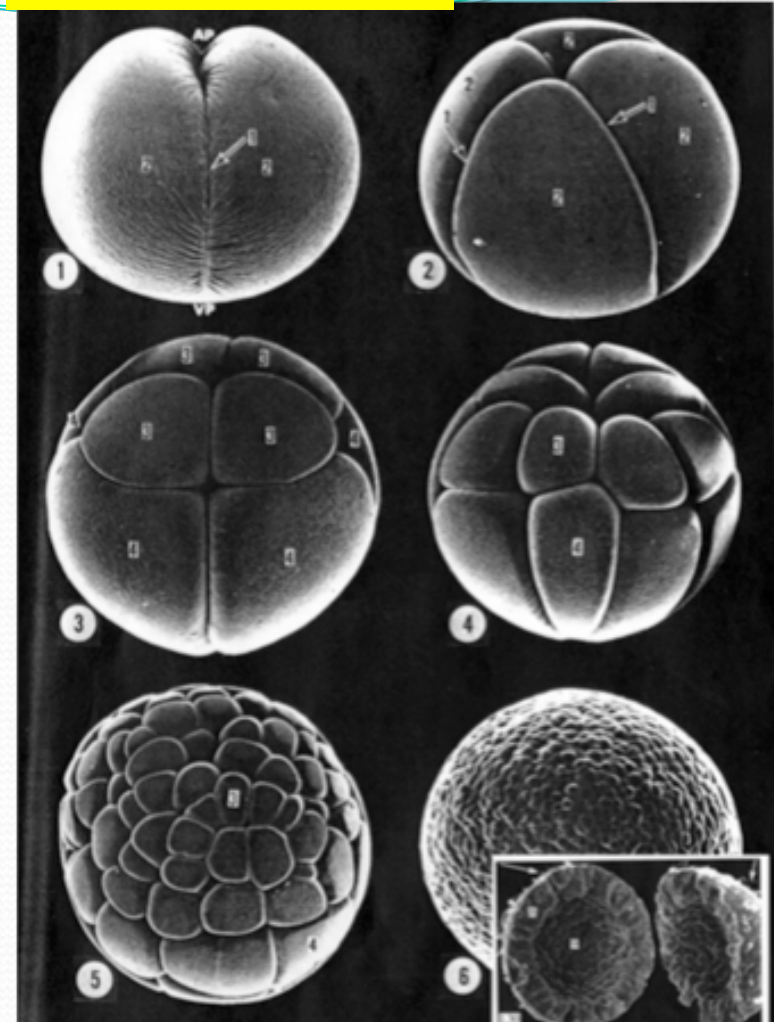


Given a normal menstrual cycle, when could pregnancy occur?

Zygote (2n)

Cell Cleavage

- Zygote undergoes **mitotic** divisions (**cleavage**) to form ball of cells called **morula** (16-32 cells by day 5)
- Morula develops into **blastocyst** (day 7)



Morula (2n)

**Blastocyst
(2n)**

Blastocyst

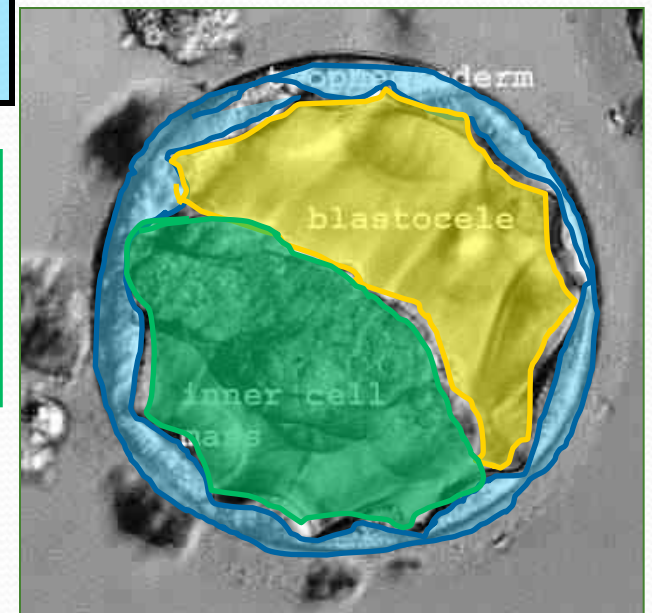
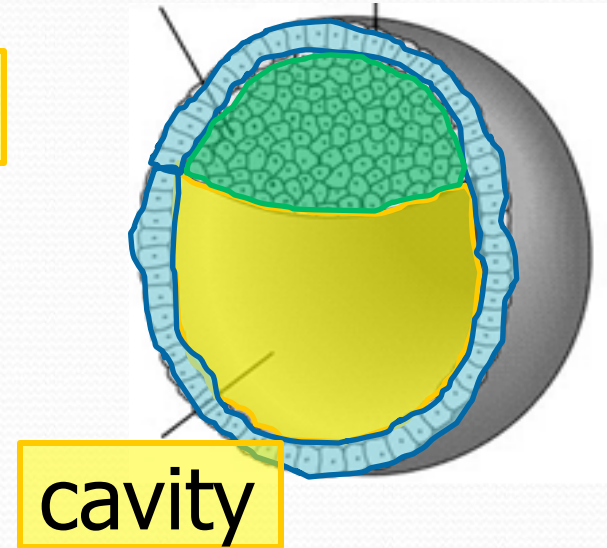
inner cell mass

Chorion

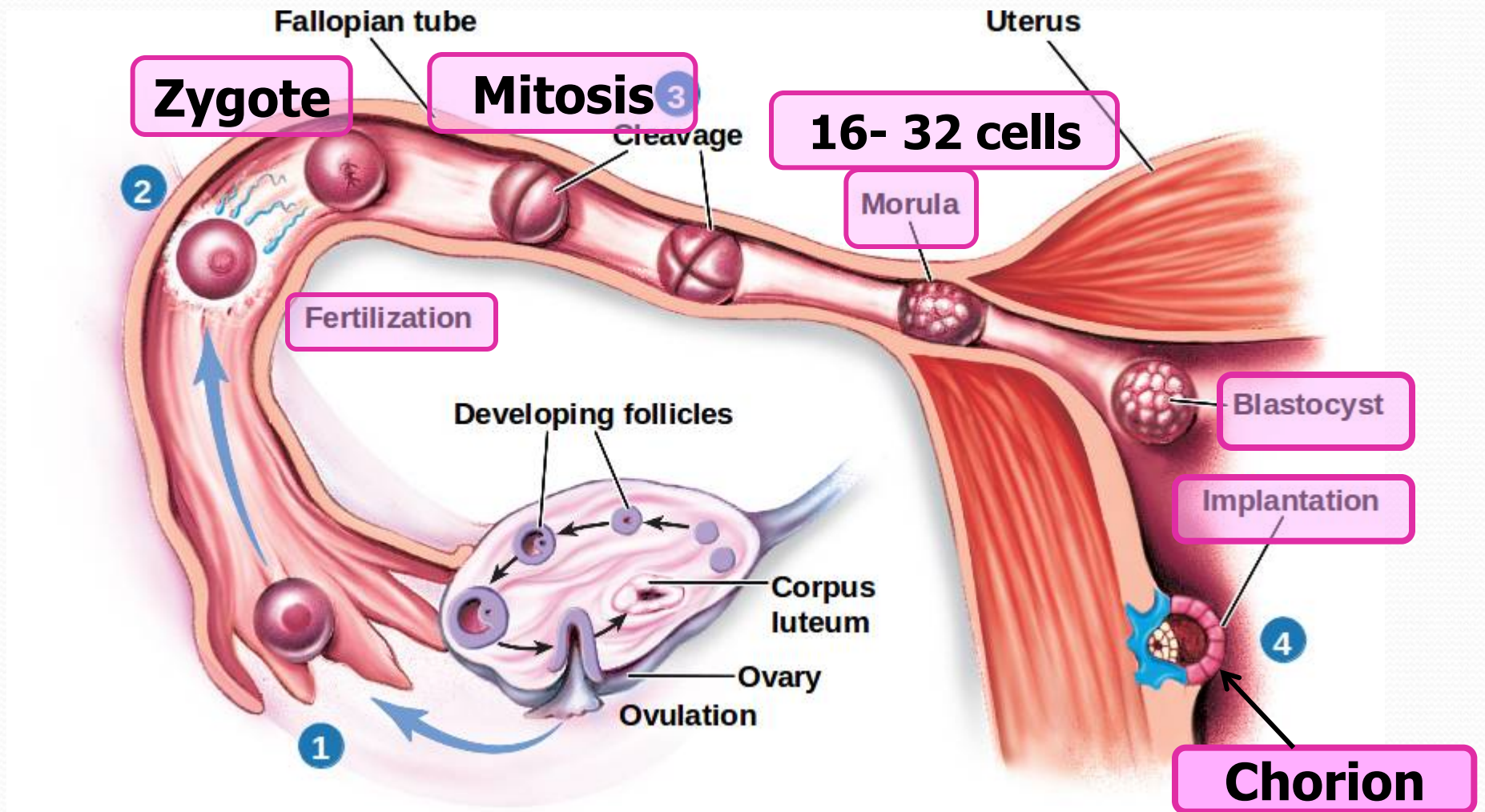
a cavity (space) opens up in the morula

- **Chorion (trophoblast):** outer layer of blastocyst
 - ▣ **Chorion forms placenta and the amnion**

- **inner cell mass:** will develop into **embryo**



From Ovulation to Implantation



From Ovulation to Implantation

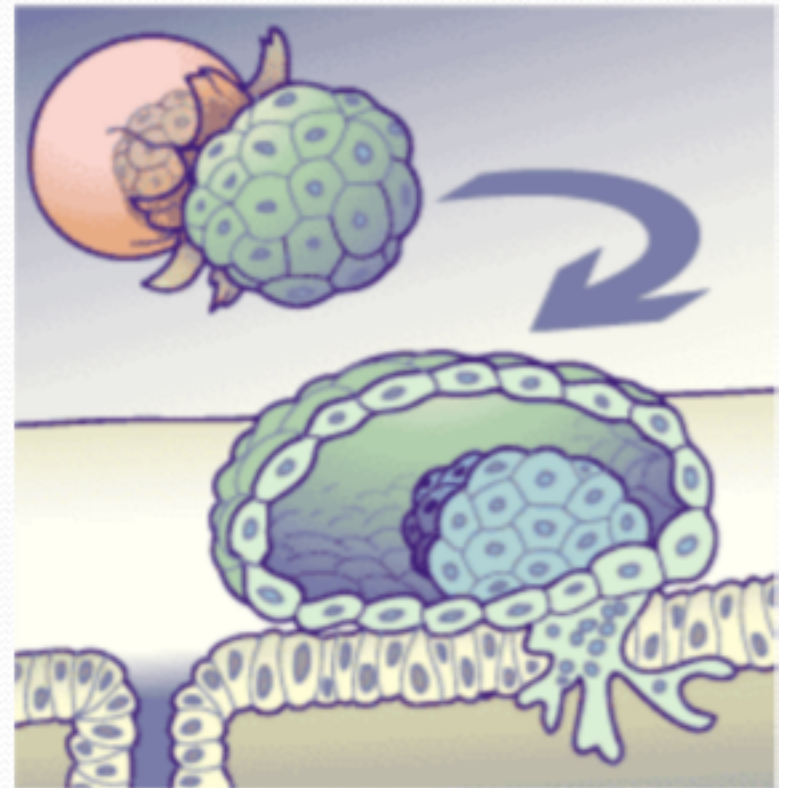
- **Day 1:** First Cleavage – cell divides by **mitosis**
- **Day 4:** 16 – 32 cell stage. Ball of cells is called a **morula**.
- **Day 5:** the cells of the morula begin to move around to form an inner and outer layer of cells. The outer layer of flattened cells (chorion) are important for **implantation in the uterine lining**.
- **Day 7:** The two layers of cells arrange themselves around a hollow fluid filled cavity called the blastocoel, the actual cell mass is called a **blastocyst**.

From Ovulation to Implantation

Day 8: Implantation

1. The blastocyst, by means of villi and enzymes secreted by the **chorion** (the membrane that forms around it), **implants** itself in the endometrium thus resulting in **pregnancy (gestation)**.

2. The **chorion** secretes **hCG, a hormone** which stimulates the corpus luteum to produce progesterone and estrogen for the first 3 months.

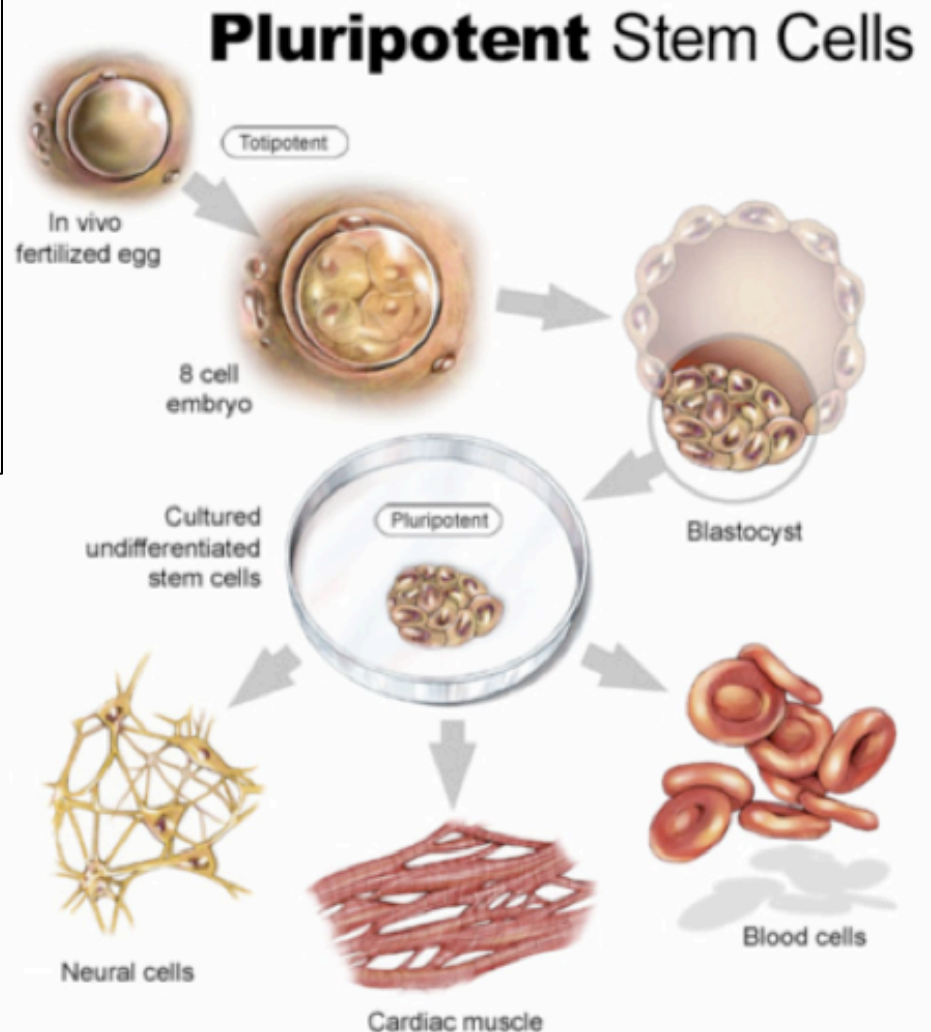


STEM CELLS

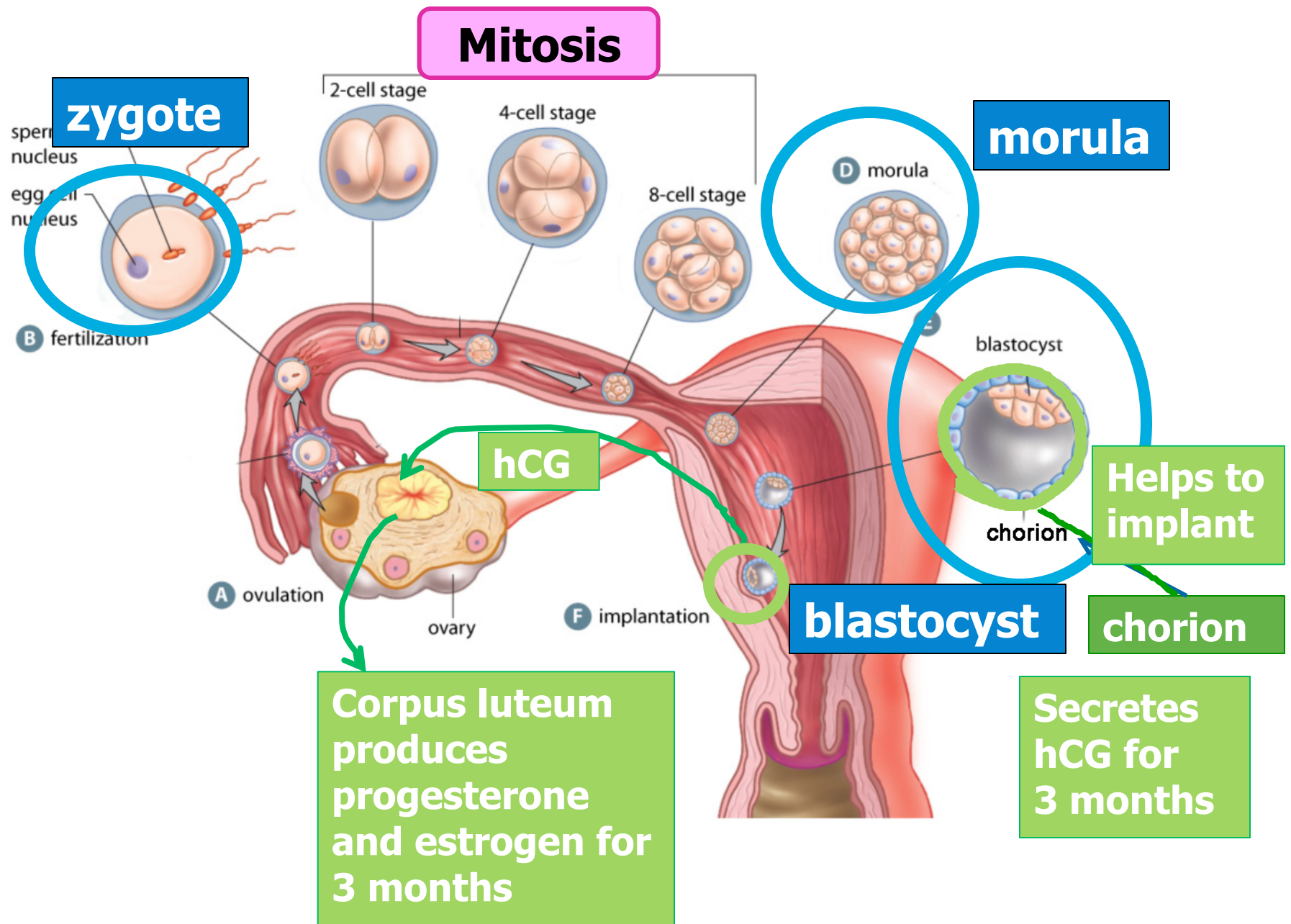
Stem cells from the blastocyst are **undifferentiated** ...can develop into any cell in the body and can be used for **stem cell** research.

First Spinal Cord Stem Cell Surgery (3 min)

A stem cell Story (15 min)

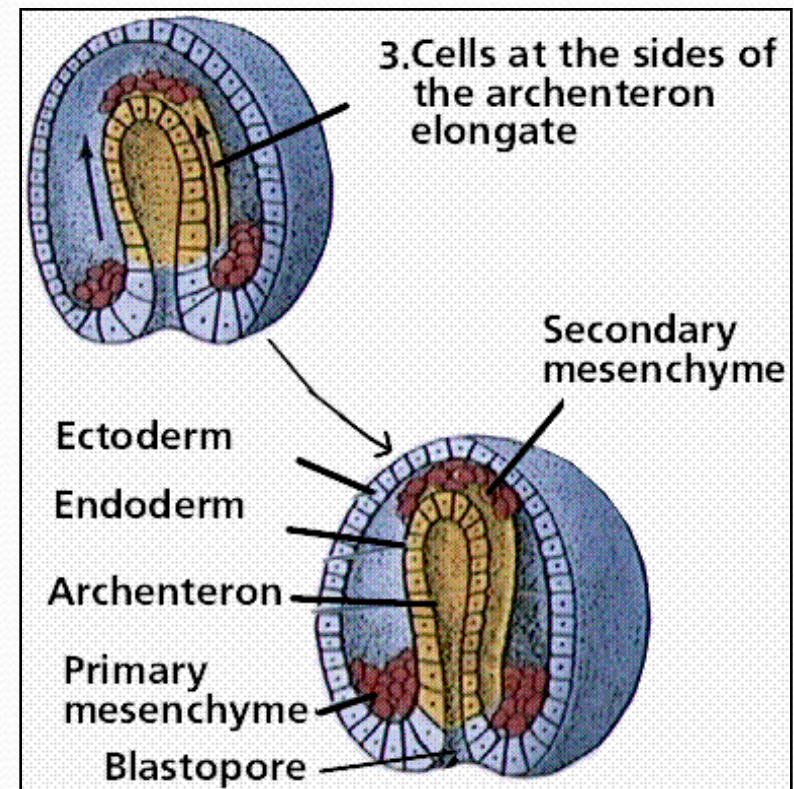
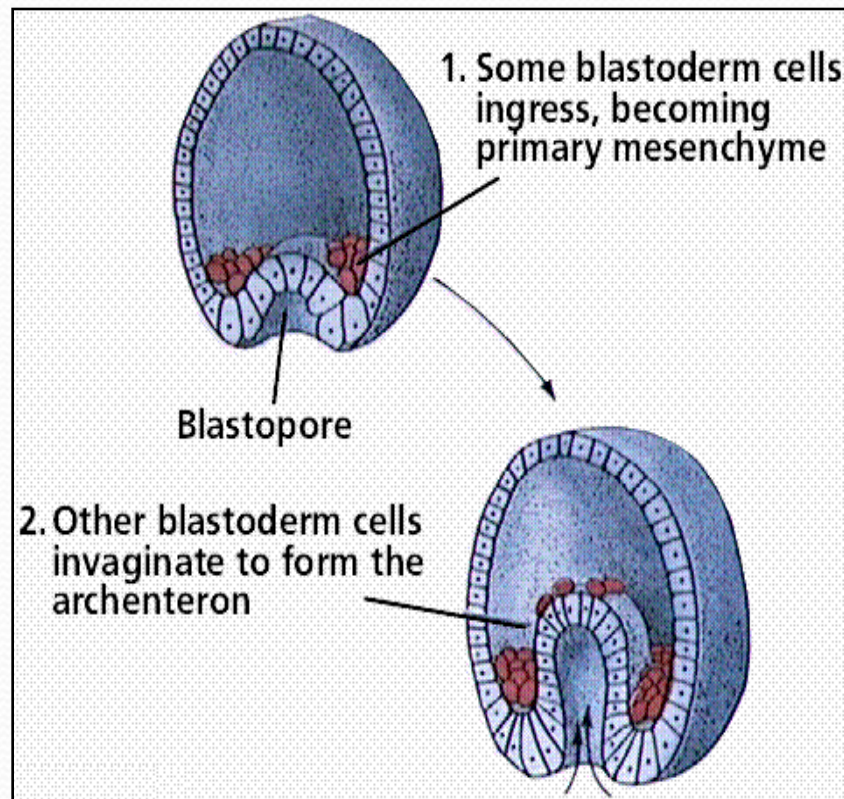


REVIEW THE STEPS:



Gastrulation (~Day 7)

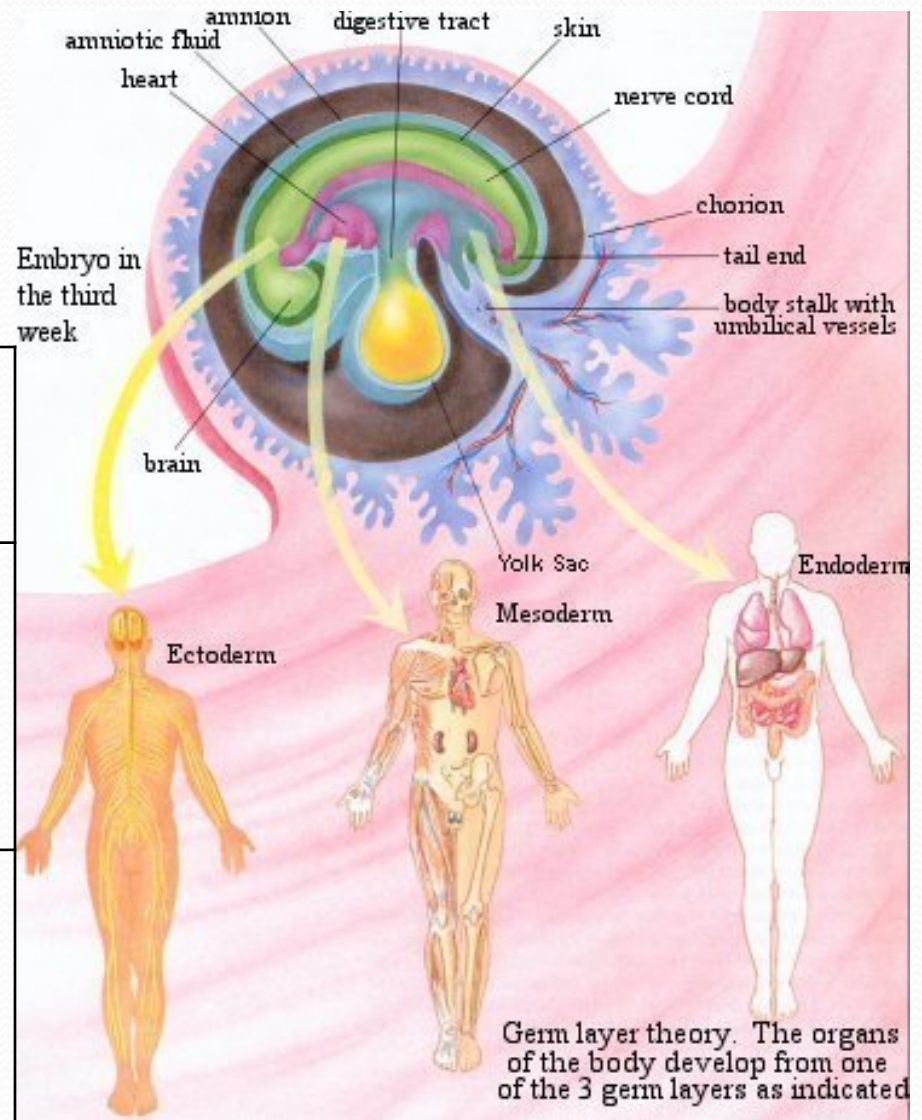
- **Gastrulation** is the process in which the **inner cell mass of blastula** turns into **3 germ layers** (embryonic tissues) – the (**ectoderm, mesoderm, endoderm**)
- embryo now called **gastrula**



Gastrulation (~Day 7)

Cells begin to differentiate (change) to form specific organ systems!

Ectoderm	-nervous system -epidermis (skin)
Mesoderm	- S keleton - M uscles - G onads (reproductive structures) <u>So Many Gonads</u>
Endoderm	- R espiratory system - D igestive a - E ndocrine glands <u>R.E.D.</u>

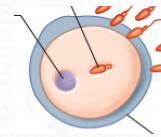


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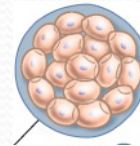
How to remember the stages?

Zebras **M**ake **B**etter **G**uacamole **E**very **F**riday

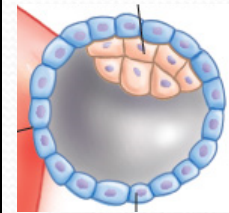
Zygote – Day 0 (Sperm + egg)



Morula – Day 4 (16 – 32 cells)



Blastocyst – Day 6 ****Implantation** Outer layer (chorion) helps the implantation process, secretes hCG and forms placenta



How to remember the stages con't...

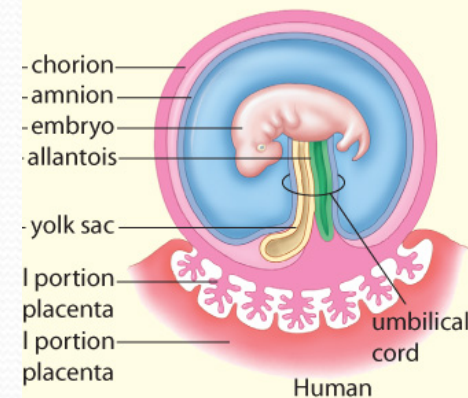
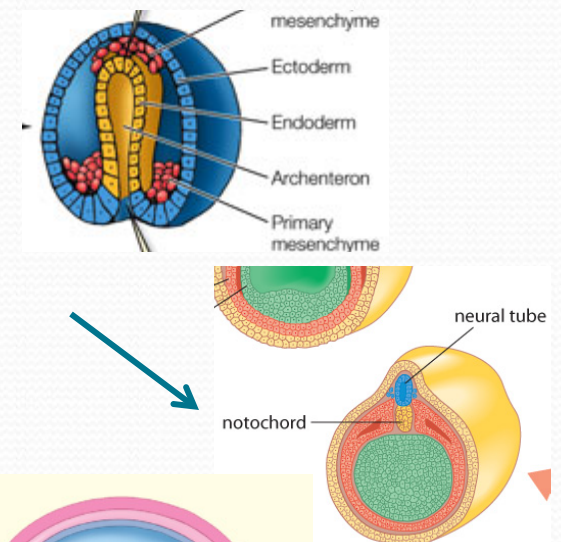
Zebras Make Better **G**uacamole **E**very **F**riday

Gastrula – Day 7 - 3 germ layers – ectoderm, mesoderm, endoderm.

Neurulation – formation of neural tube which will form CNS.

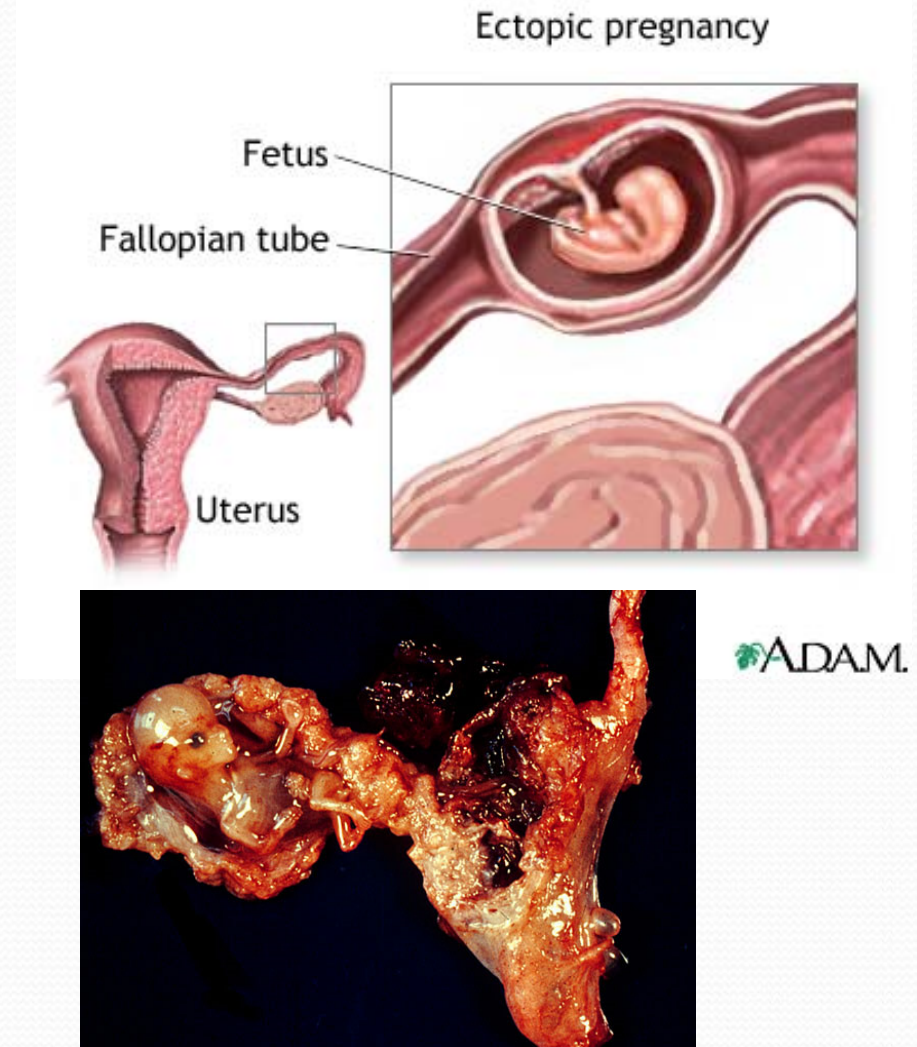
Embryo – Day 10 - **chorion** starts to form the **placenta**

Fetus – week 8 – called fetus because all major organ systems have started to develop



Ectopic Pregnancy: Faulty Implantation

- In an ectopic pregnancy, a fertilized egg has implanted **outside the uterus**, usually in the **fallopian tube**.
- **Severe bleeding** and possible death of the mother can result from this type of pregnancy



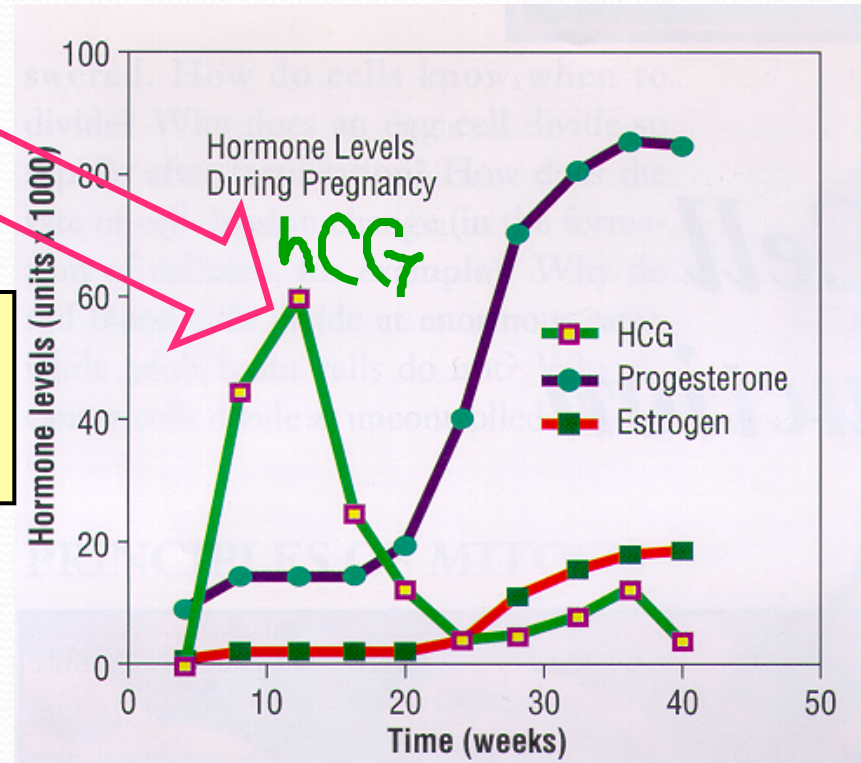
Pregnancy Tests

Outer layer of the blastocyst (the **chorion**) starts to secrete **hCG** when it implants in the endometrium on ~day 7. This causes morning sickness & is the hormone measured in a pregnancy test!

Pregnancy test: tests for the presence of hCG in the urine (sometimes the blood).

Remember hCG: similar to LH – keeps corpus luteum secreting **progesterone & estrogen for 3 months!!**

Later on, the **placenta** secretes sufficient estrogen and progesterone



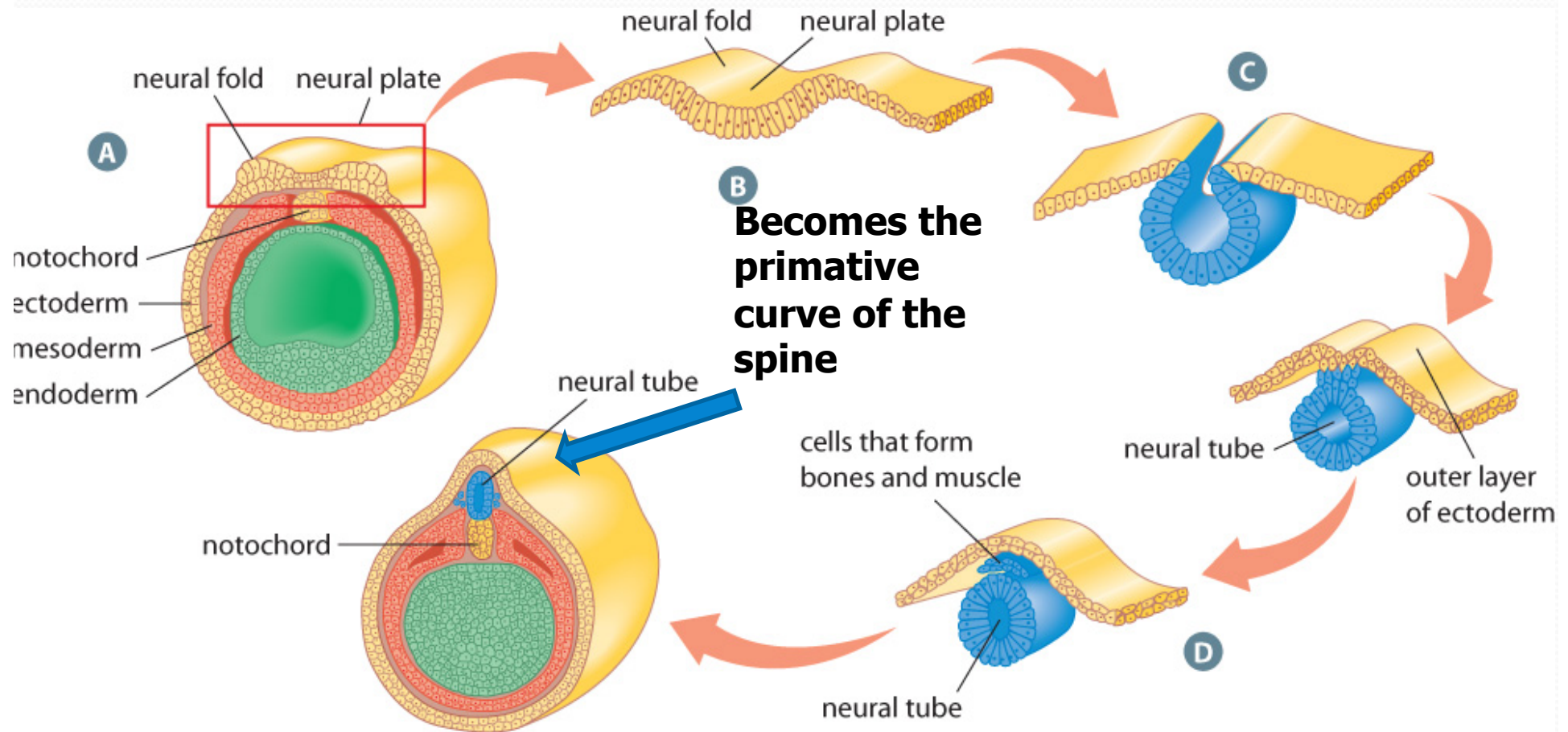
How can a miscarriage occur?

- For first 3 months **progesterone** comes from mother
- Fetus starts making it's own after **3 months**
- If mom stops progesterone and fetus does not start...
 - **Miscarriage** occurs



Neurulation: formation of neural tube → develops into **brain and spinal cord**.

Happens during the **gastrula** stage



Practice:

State the layer (ecto, meso, endo) that the part originates from

1. Lungs ____ Endo ____
2. Eye ____ Ecto ____
3. Skin ____ Ecto ____
4. Heart ____ Mes ____
5. Stomach ____ Endo ____
6. Brain ____ Ecto ____
7. Testes ____ Endo ____
8. Small Intestine ____ Endo ____
9. Teeth ____ Ecto ____
10. Spinal cord ____ Ecto ____

11. Hair ____ Ecto ____
12. Muscles ____ Meso ____
13. Pancreas ____ Endo ____
14. Hypothalamus ____ Ecto ____
15. Thyroid gland ____ Endo ____
16. Large intestine ____ Endo ____
17. Bones ____ Meso ____
18. Finger nails ____ Ecto ____
19. Ovaries ____ Meso ____