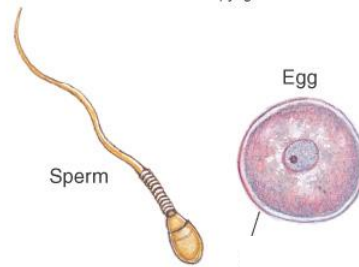


# Gamete development and embryo development

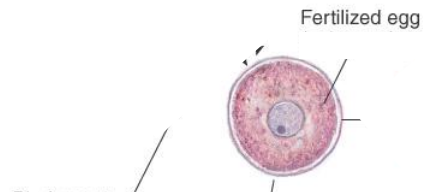
# What is a stem cell?

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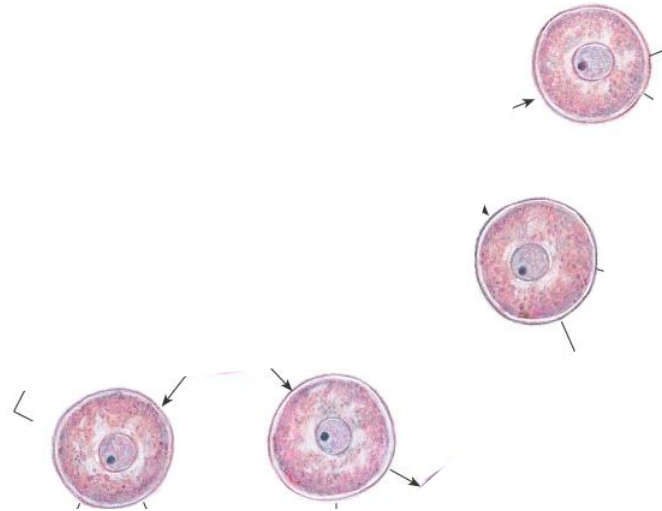
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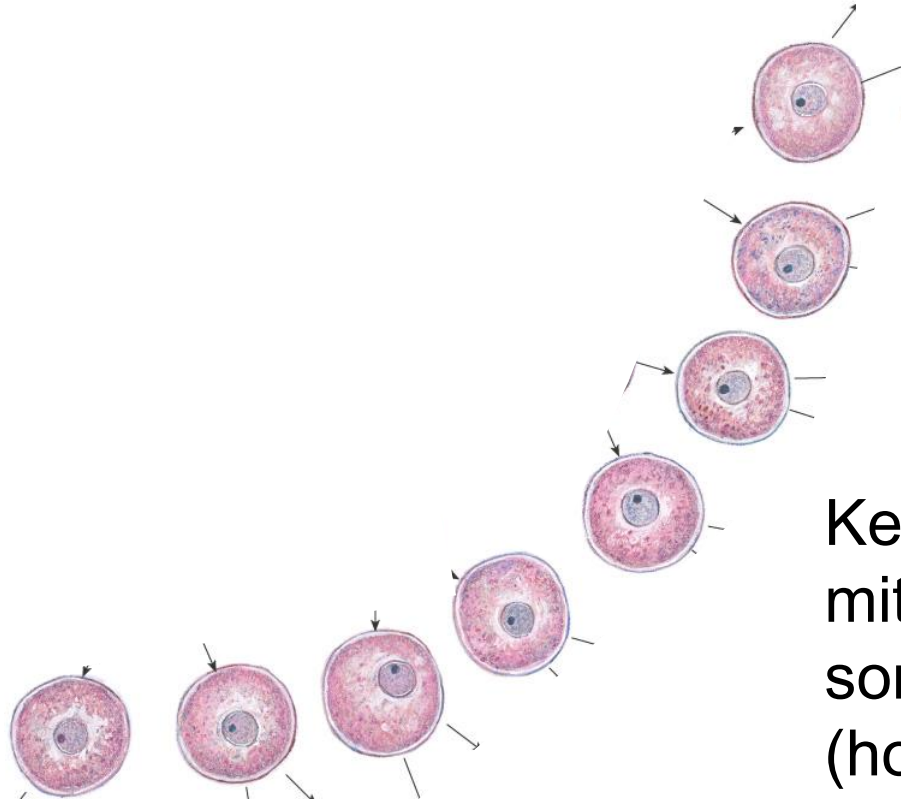
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# What is a stem cell?

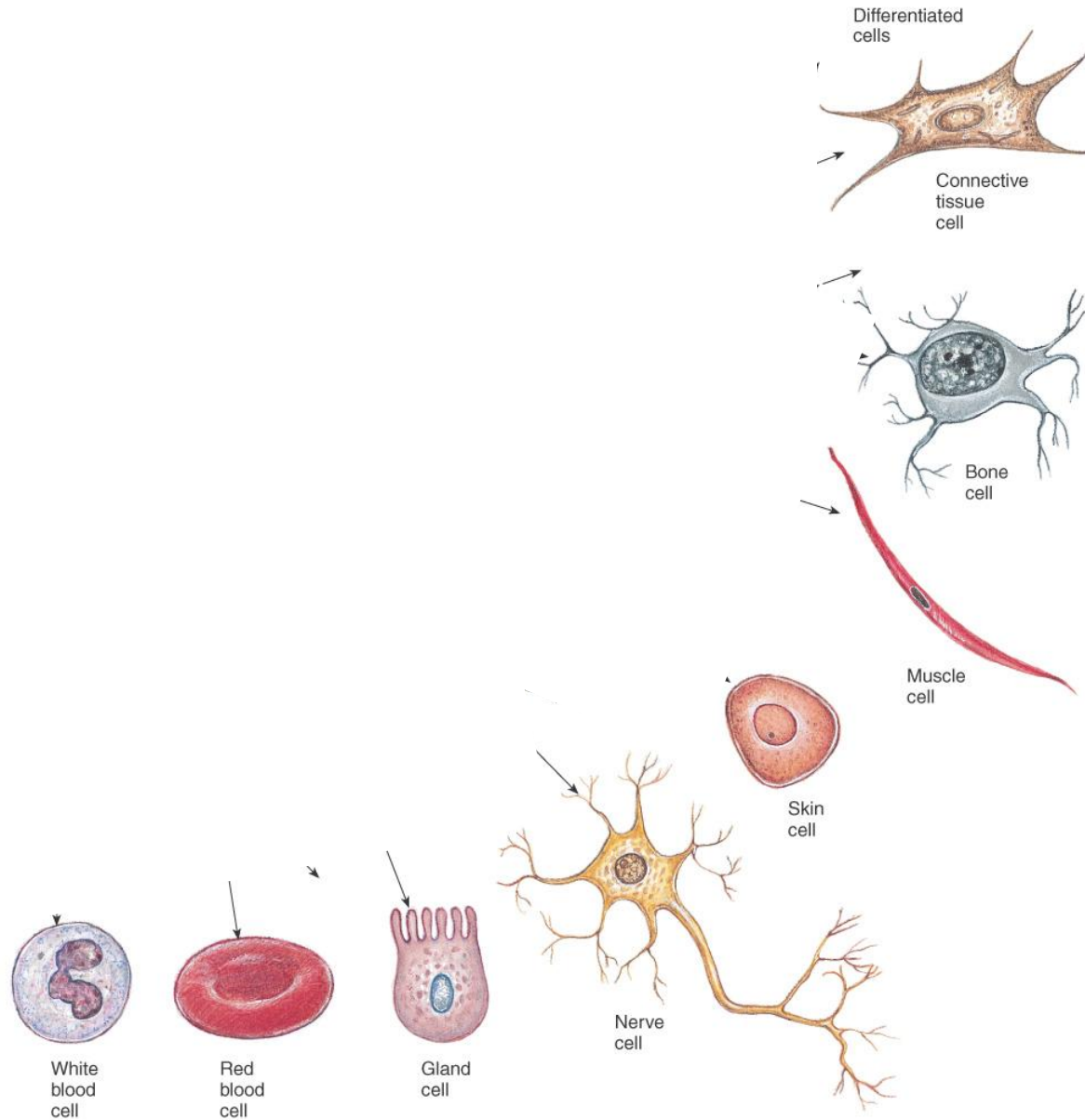
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Keep undergoing mitosis until something (hormones or other chemical tells them)

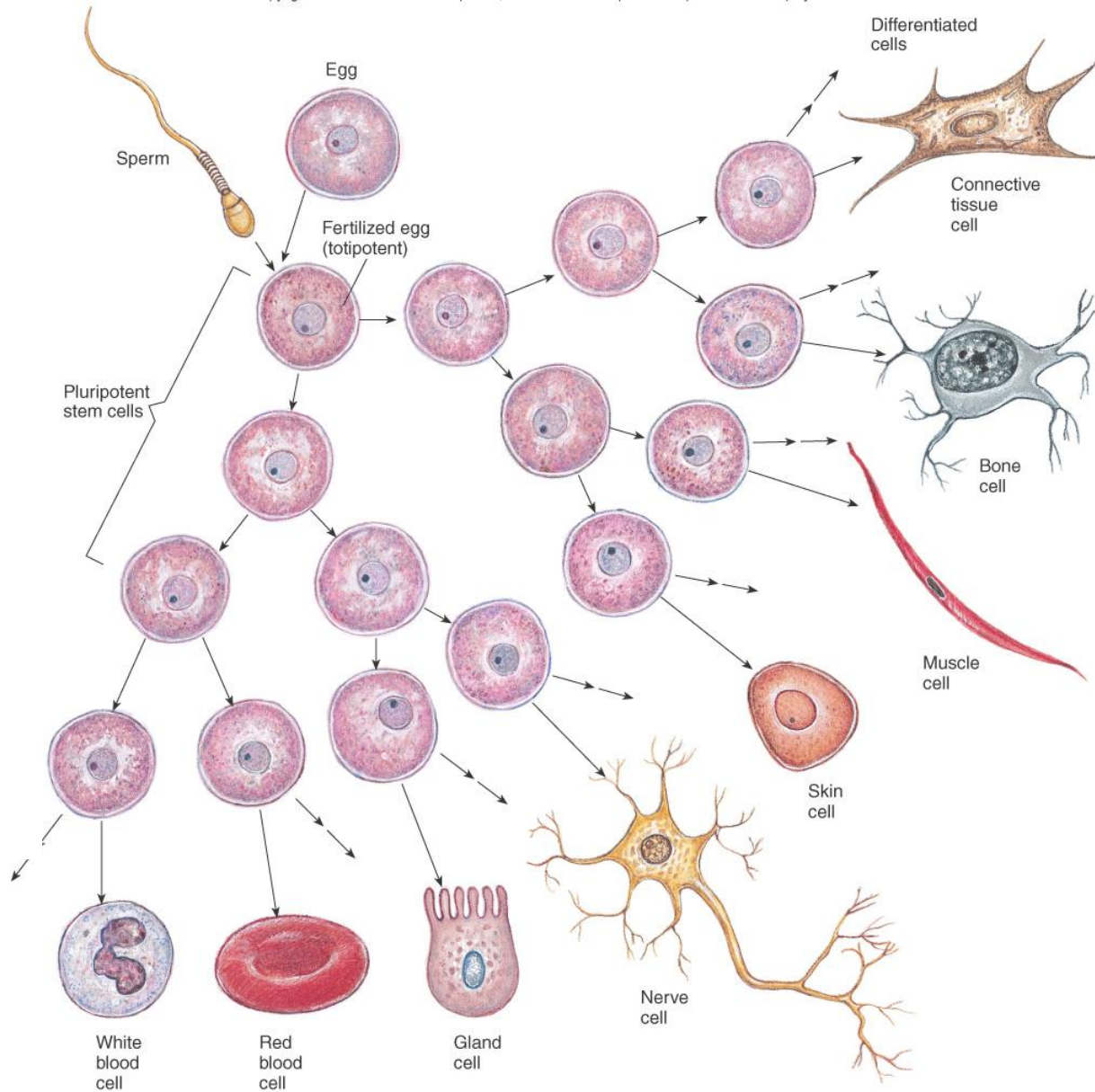
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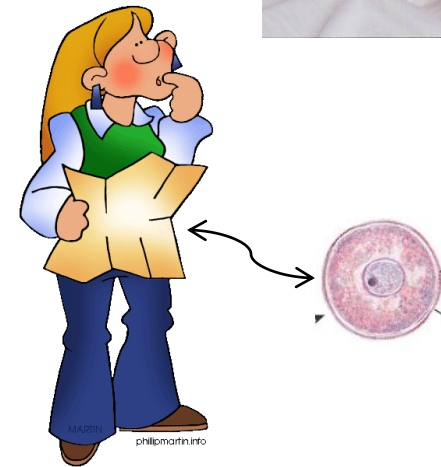
# Stem Cells

Cells that contain all of our genetic information –

**Not just in the umbilical cord**

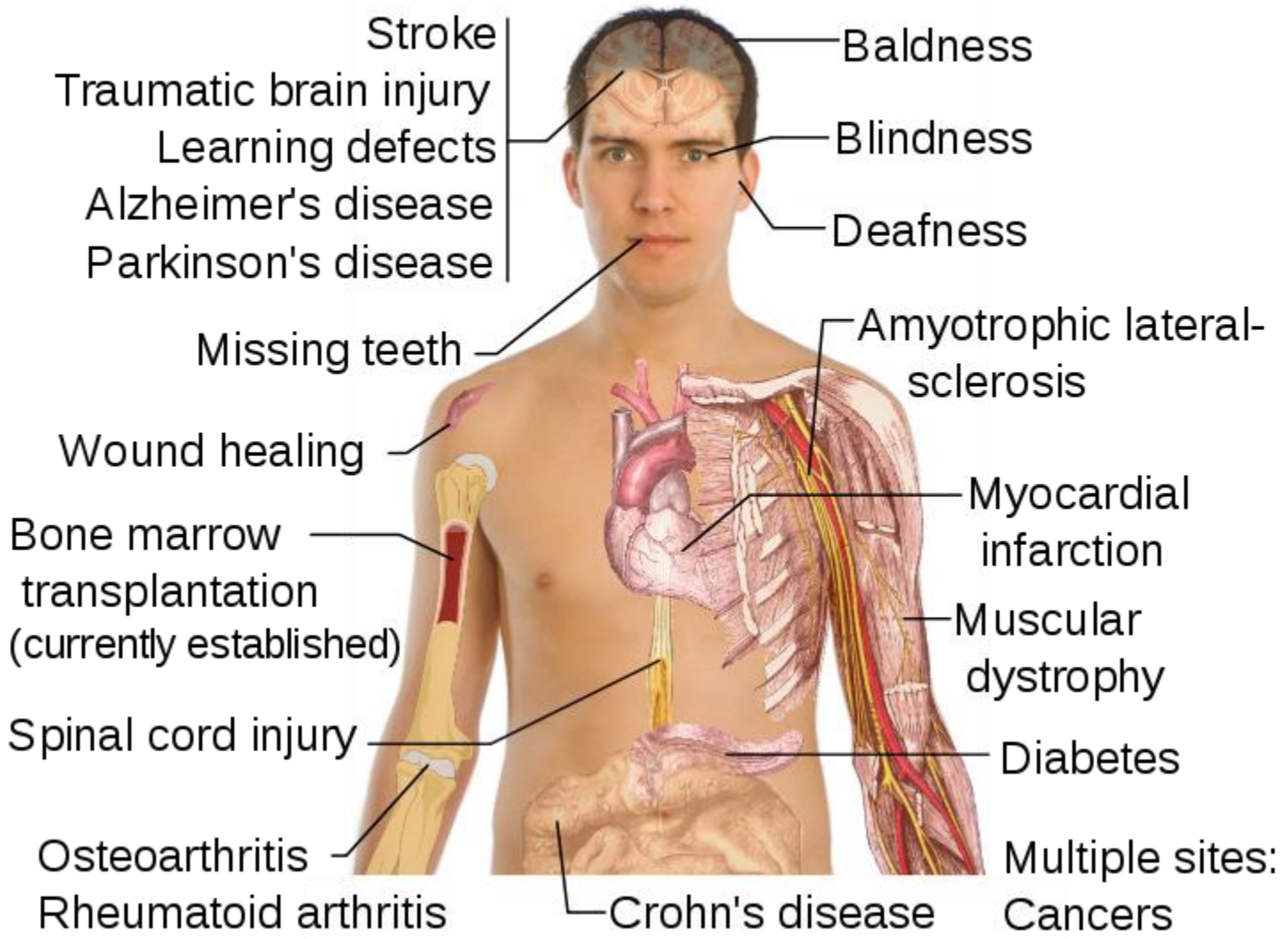
complete directions to build a person (or frog or...).

- Bone marrow (to make blood)
- Testes (to make sperm)
- Embryo (first two weeks)
- Umbilical cord
- Various other areas in body



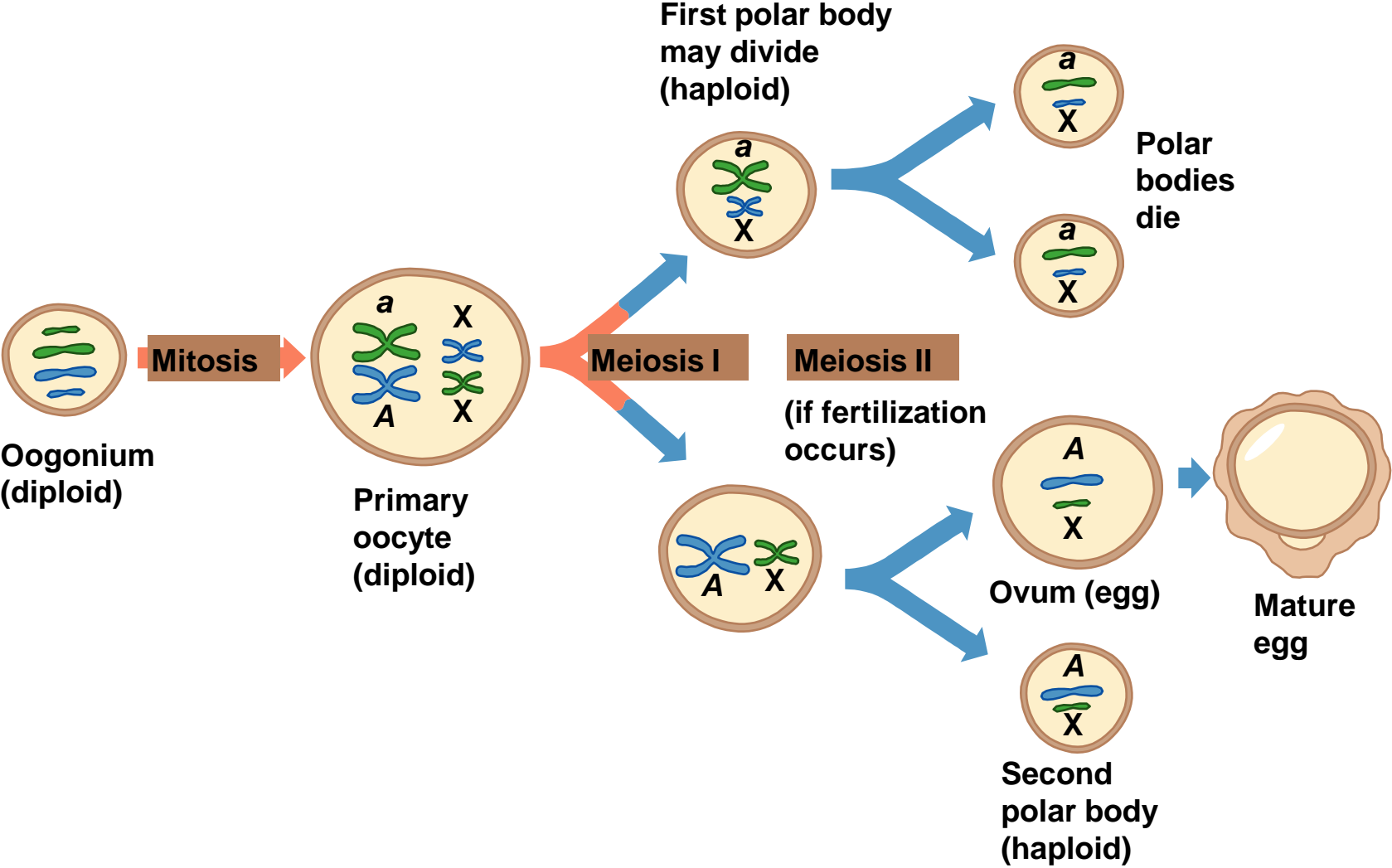
Stem cell "lines" can be maintained by taking cells from embryos and let them divide in a culture condition that allows them to keep dividing without forming any tissue.

### Potential uses of **Stem cells**



*At present, no new stem cell lines can be created using government money.*

# Oogenesis



# Oogenesis

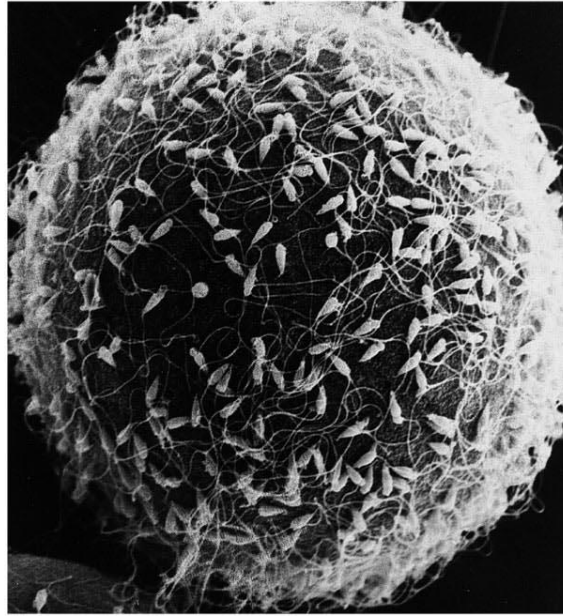
- Eggs are created in the embryo, before birth
- These eggs begin meiosis (before birth) and stop just before the first division.
- **Puberty**: ovulation once a month, egg completes its first division and is released from the ovary
- It begins the second division, but does not complete the process **unless fertilized!**
- On average, a woman will ovulate about 400 eggs between puberty and menopause.

# Spermatogenesis

- Stem cells that will make sperm are present at birth
- **Puberty**: the stem cells undergo mitosis to make spermatocytes
- Proceed immediately into meiosis and produce spermatids that mature into sperm – 48 day cycle.
- Each orgasm produces about *400 million* sperm cells.

# Fertilization

(A)



(

- As soon as one sperm gets into the egg, a chemical reaction occurs, preventing additional sperm from entering.

# What would happen if two sperm fertilized the egg?

- a. Embryo would have 3 copies of every chromosome
- b. Embryo would have normal chromosomal content
- c. Embryo would develop normally
- d. Embryo would die
- e. A and D

# Twins

- Fraternal
  - Two separate eggs ovulated.
  - *Just like any other siblings.*
- Identical
  - A fertilized egg splits into two.
  - *Share exact genetic material*

# Reproductive problems and technology

## Male infertility

About 1 in 25 men are infertile (4%) (usually a problem with Y chromosome genes)

**Female infertility:** more things can go wrong

- failure to ovulate
- cystic ovaries
- failure of uterine lining to thicken
- abnormal thickening of lining (endometriosis)
- blocked Fallopian tube
- failure of implantation, etc.



# **Defects during development can be caused by**

- recessive disease that both parents carry (Molly's case)
- complete loss or duplication of a chromosome
- can have pieces rearranged
- can trade material

# Abnormal chromosome structure

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Normal sequence of genes:

a.



Deleted sequence of genes:

b.



Duplicated sequence of genes:

c.

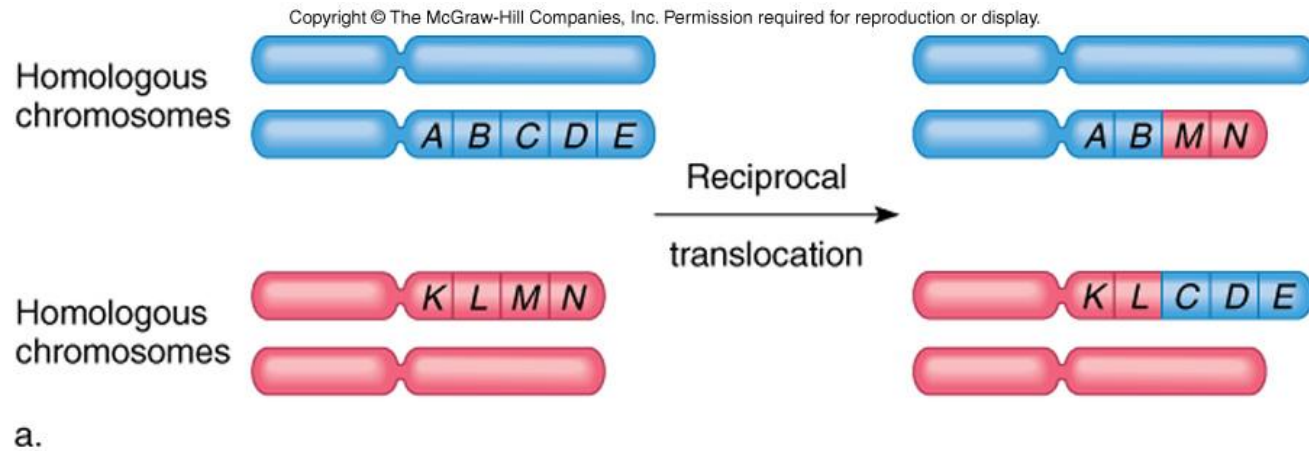


Inverted sequence of genes:

d.



# Translocations



All parts of all chromosomes are present so person is usually normal.

Problems arise if a gene is interrupted

Next generation can be affected

# Miscarriage

Our body's way of taking care of most chromosomal defects - "mistakes".

- 30% of all pregnancies - usually in first 6 weeks
- 60% of early miscarriages are genetic problems
- Rate of miscarriage increases with age of both men and women.
- 3 or more in a row considered a case for further investigation.

# In Vitro Fertilization (IVF)

1. Super-ovulation is induced in mother to be
2. Multiple eggs removed
3. Combined with sperm
4. Check for healthy ones
5. Fertilized embryos/blastocysts are implanted in uterus
  - If 2 embryos have a 50-60% for 1 and 30% both
6. Extra embryos are frozen

Variations: egg donated, sperm donated, surrogate mother, etc...

# Pre-implantation Genetic Screening or Diagnosis (PGS or PGD)

Detection of genetic abnormalities prior to implantation.

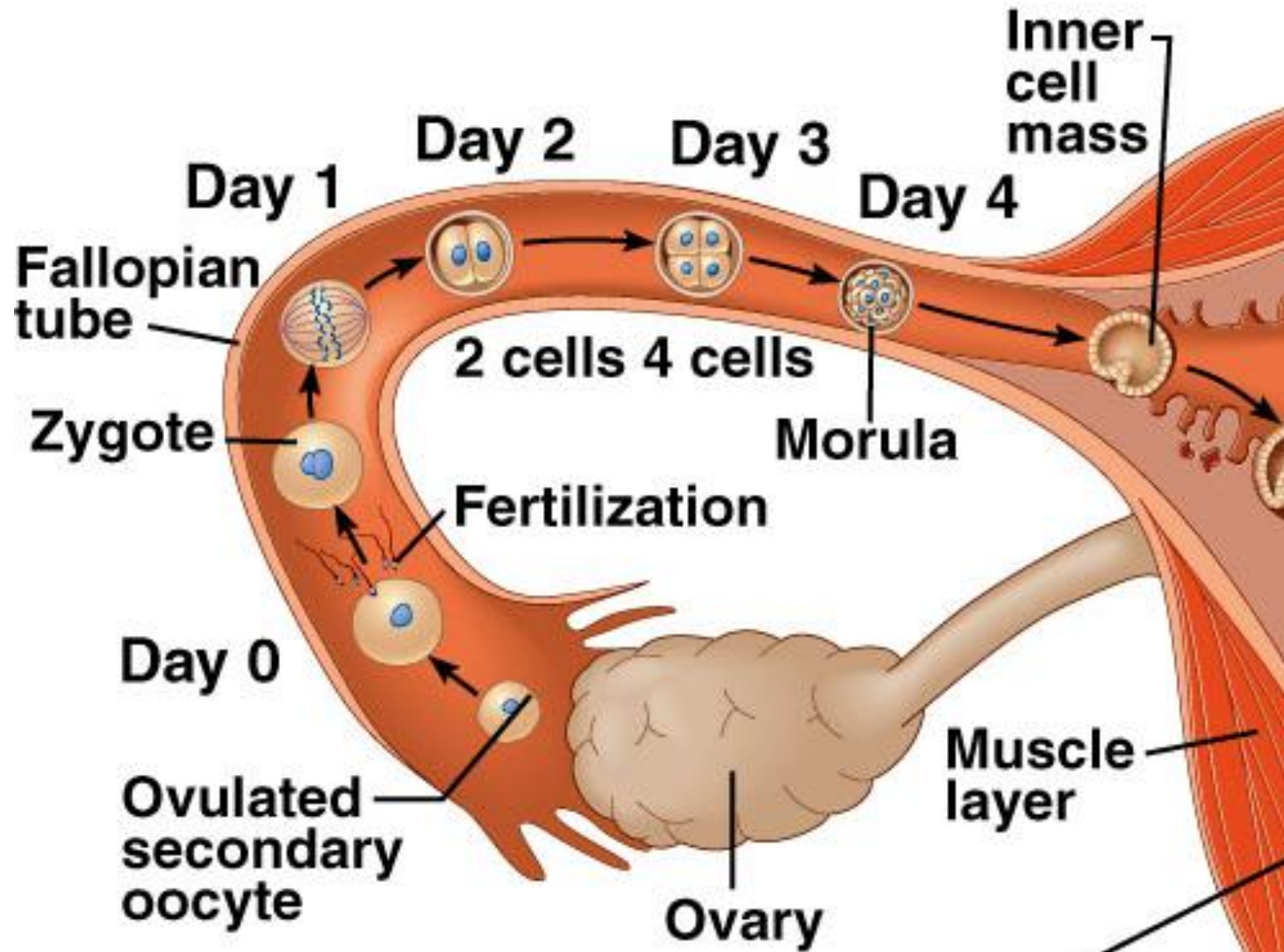
PGS – checks for number of chromosomes

PGD – checks for specific diseases like cystic fibrosis  
(can also tell gender)

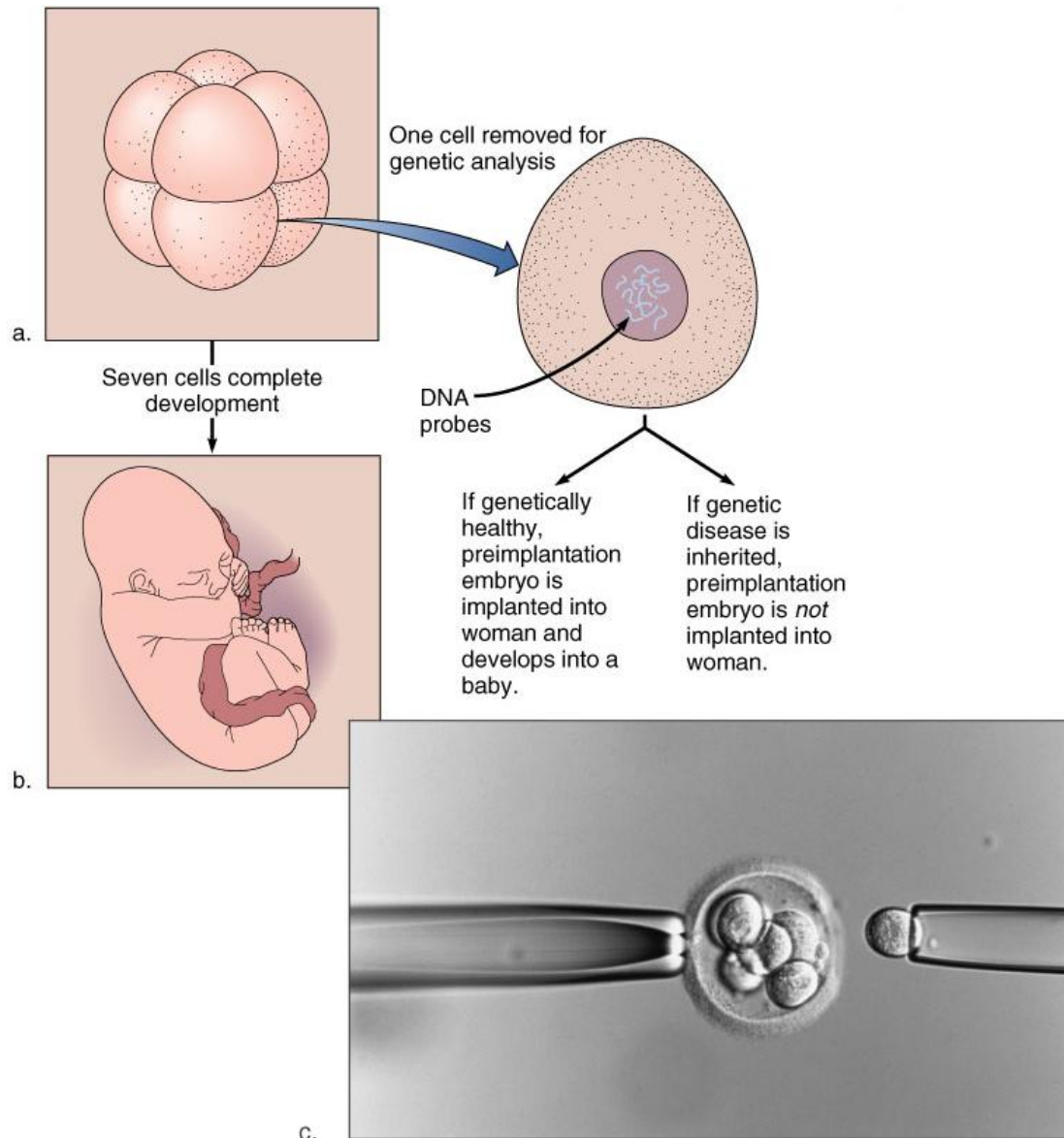
Since June 2008 can screen all 23 chromosomes

- Time consuming so flash freeze embryos
- Gives mom time to recover from egg harvesting.

# Early development: ovulation to implantation



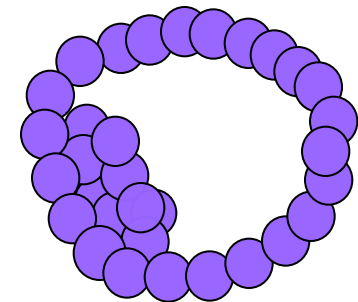
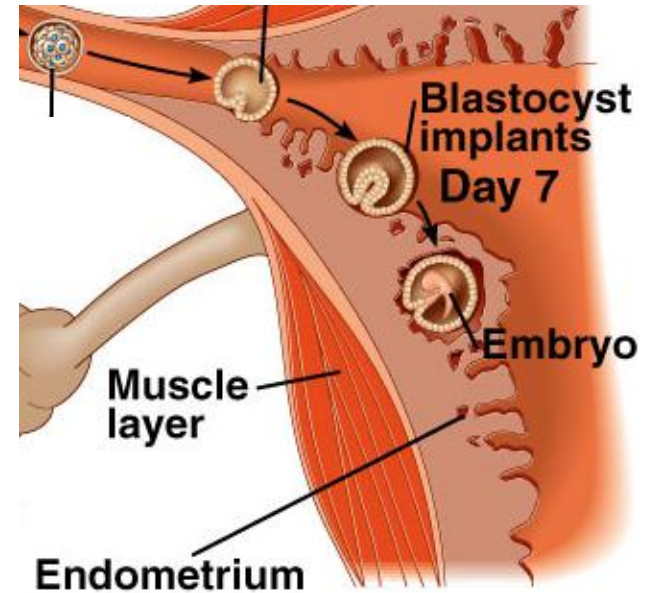
# Cell Removal





# Blastocyst

The developing embryo becomes a hollow ball of cells and is called a .blastocyst.





Molly Nash, suffering from Fanconia Anemia with brother Adam, whose stem cells saved her life, and Dr. Wagner.

# "Spare" Embryos: ethical concerns

Fertilized embryos that are not implanted can be donated for research purposes

Stem cell "lines" can be maintained to help cure all sorts of diseases and ailments.

Using IVF and PGS or PGD, a prospective child can be "screened" to see if they are healthy, or even if they are a match for donating stem cells to a sibling.

