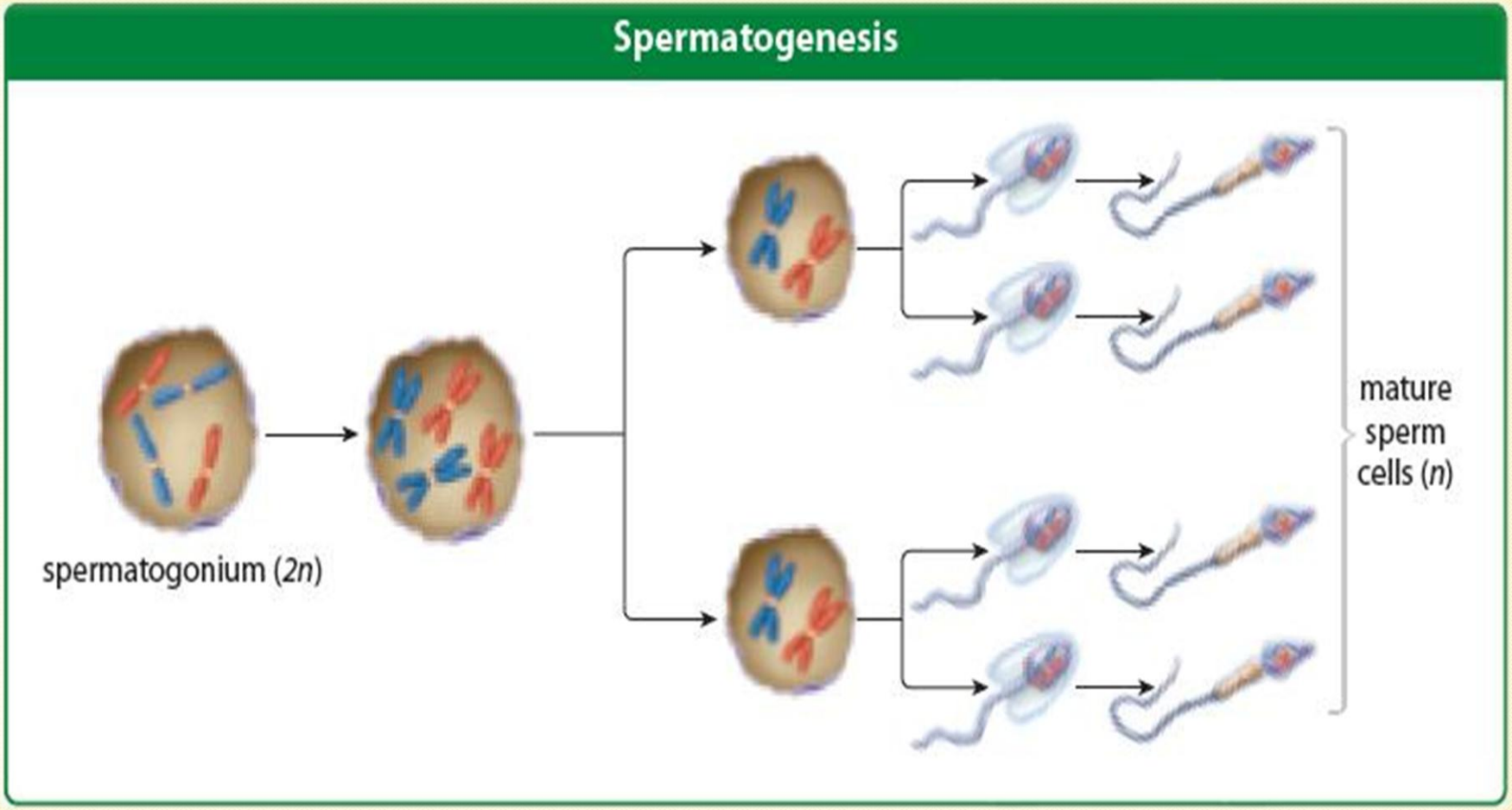
Gamete Formation in Animals

EGG AND SPERM CELL FORMATION

Spermatogenesis

- The process of male gamete (sperm cell) production in mammals.
- In most males, spermatogenesis takes place in the testes (male reproductive organs).
- Spermatogenesis begins with a diploid germ cell called a spermatogonium.
- The final product is four (4) viable haploid sperm cells.

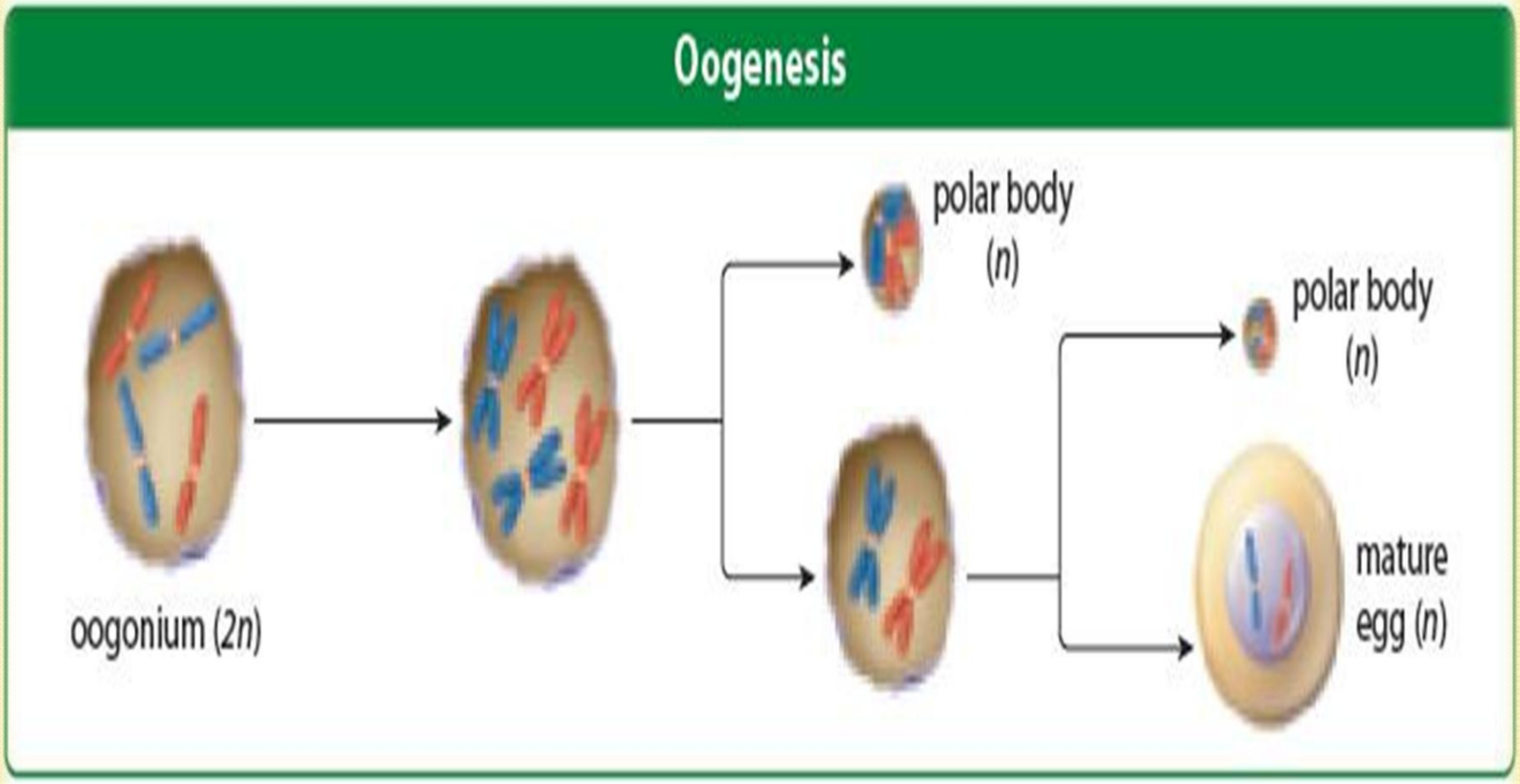
Spermatogenesis



Oogenesis

- The process of female gamete (egg cell) production in mammals.
- Meiosis, in most females, takes place in the ovaries.
- Oogenesis starts with a diploid germ cell called an oogonium.
- During meiosis I and II the cytoplasm is unequally distributed resulting in only one (1) viable haploid egg cell. This is to ensure that the developing zygote has sufficient nutrients.

Oogenesis



Multiple Births

- Sometimes, a woman gives birth to more than one baby at once.
- This can happen when more than one egg is released. For example, if two eggs are released and both are fertilized, fraternal twins are born.
- If a single zygote divides into two separate bodies in the first few days of development, identical twins may be born.

Errors During Meiosis

- The two processes that produce genetic variation, independent assortment and crossing over, also provide the potential for chromosomal abnormalities.
- Although many of the errors that occur during meiosis produce gametes that cannot survive, some do survive, are fertilized, form into zygotes with one of two types of chromosomal errors:

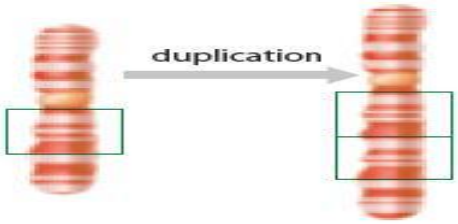
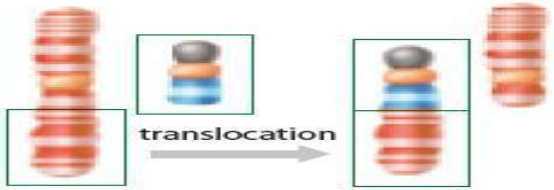
1. Changes in Chromosome Structure.
2. Changes to Chromosome Number.

Changes in Chromosome Structure

- During crossing over, the chemical bonds that hold the DNA together are broken and reformed.
- Sometimes, the chromosomes do not reform correctly.
- Errors in chromosome structure include:

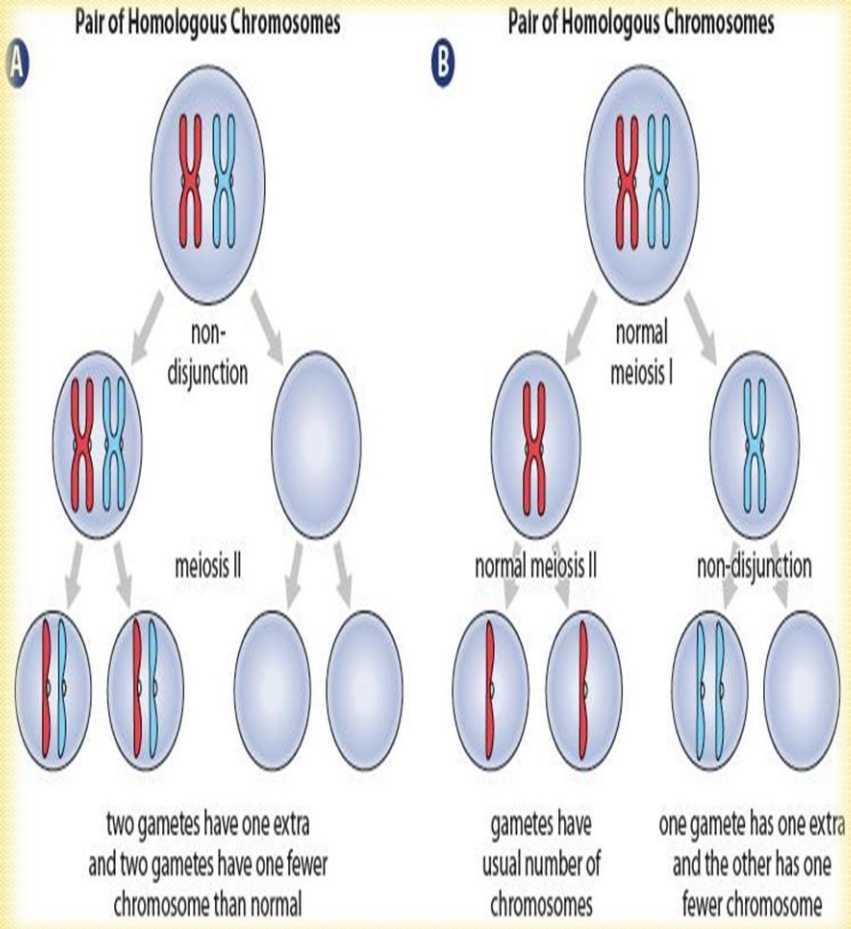
1. Deletion – a piece of a chromosome is deleted
2. Duplication – a section of a chromosome appears two or more times in a row
3. Inversion – a section of a chromosome is inverted
4. Translocation – a segment of one chromosome becomes attached to a different chromosome

Errors in Chromosome Structure

Error in Chromosome Structure	Example of Genetic Disorder
	**Cri du Chat** Cri du Chat (French for "cry of a cat") syndrome is caused by a deletion in chromosome 5. Many children with this syndrome cry with a high-pitched, catlike sound. Other symptoms include low birth weight, widely spaced eyes, recessed chin, and developmental and cognitive delays. There is no cure for this disorder.
	**Charcot-Marie-Tooth Disease** Most cases of Charcot-Marie-Tooth disease are caused by duplication of a gene on chromosome 17. The most common symptoms are muscle weakness and loss of some sensation in the lower legs, feet, and hands. A high foot arch with constantly flexed toes is often present. There is no cure for this disorder.
	**FG Syndrome** A form of FG syndrome is caused by the inversion of a section of the X chromosome. This syndrome occurs almost exclusively in males. Symptoms include intellectual disabilities of varying degrees, delayed motor development, low muscle tone, and broad toes and thumbs. There is no cure for this disorder.
	**Chronic Myelogenous Leukemia** Most cases of chronic myelogenous leukemia (CML), which is a cancer of the white blood cells, are caused by a translocation between chromosome 9 and 22. This results in the formation of an abnormal gene. Treatment of CML involves using a drug that stops the increased production of white blood cells that the abnormal gene causes.

Errors Caused by Changes in Chromosome Number

- Sometimes homologous pairs or sister chromatids do not separate as they should during meiosis.
- This phenomenon is call non-disjunction.
- Non-disjunction produces gametes with too few or too many chrosmosomes.



Chromosomal Abnormalities in Humans

Conditions	Number of Live Births	Syndrome	Characteristics
Autosome			
Trisomy 21	1 in 800	Down	Intellectual disabilities, abnormal pattern of palm creases, almond-shaped eyes, flattened face, short stature
Trisomy 18	1 in 18 000	Edward	Intellectual and physical disabilities, facial abnormalities, extreme muscle tone, early death
Trisomy 13	1 in 15 000	Patau	Intellectual and physical disabilities, wide variety of defects in organs, large triangular nose, early death
Sex Chromosome			
XXY	1 in 1000 males	Klinefelter	Sexual immaturity (inability to produce sperm), breast swelling
XYY	1 in 1000 males	Jacobs	Typically no unusual symptoms; some individuals may be taller than average
XXX	1 in 1500 females	Triple X	Tall and thin, menstrual irregularity
XO (1 X chromosome, only)	1 in 5000 females	Turner	Short stature, webbed neck, sexually underdeveloped

Prenatal Genetic Testing

- Prenatal genetic testing refers to tests performed on a fetus (a developing baby still in the womb) that are based on testing for genetic-based abnormalities.
- Reasons for testing include:

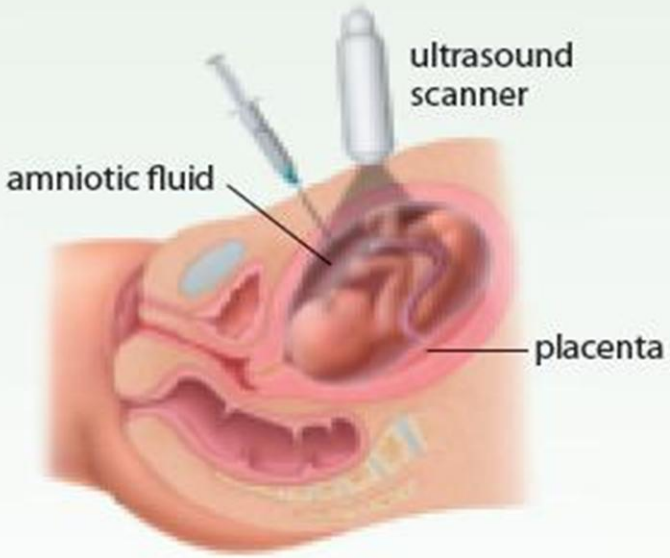
1. Women aged 35 and older.
2. Women with a family history of genetic disorder.
3. Women with significant health risk factors.

- Deciding whether to have prenatal testing performed and what to do with the information once received can create some difficult personal decisions and are often times complicated with many ethical dilemmas.

Prenatal Genetic Testing

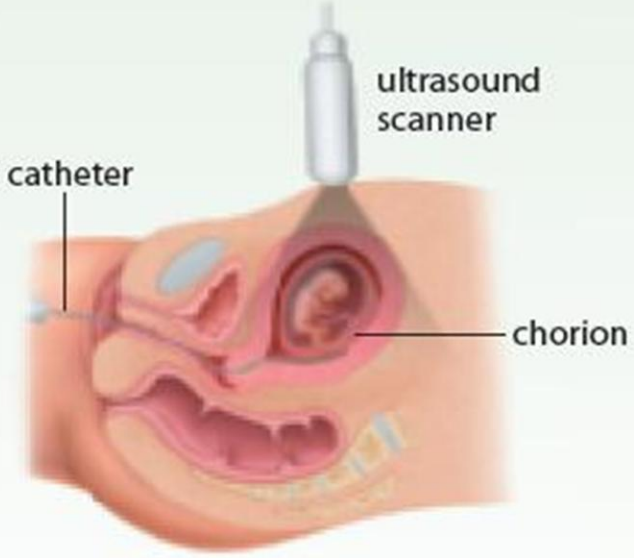
Invasive Tests

Amniocentesis



A sample of amniotic fluid (fluid surrounding the fetus), which contains fetal cells, is taken after the 14th week of pregnancy.

Chorionic Villus Sampling (CVS)



A sample of cells from the chorion (part of the placenta) is taken after the 9th week of pregnancy.