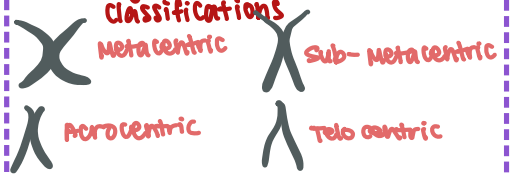
CHROMOSOMAL ABNORMALITIES

SEX DETERMINATION

- mammals: XY male, XX female
  - Y → small, little genetic information
  - X → large, many range of traits
- Birds + Snakes: ZZ male, ZW female
- Some reptiles: Environmental factors
  - female < 31.7°C - 34.5°C < male
- Lyon hypothesis
  - random inactivation of one X chromosome in every cell of a female embryo
  - females are functionally hemizygous at cellular level for X-linked genes
  - in X polysomy, all but one are inactivated

Homologous chromosome classifications



Definition

1. No. of chromosomes change
2. Structure of chromosomes change

Impacts

- foetal death / short lifespan
- development abnormalities
- infertility
- natural embryonic loss
- cancers / diseases

LOSS OF SINGLE CHROMOSOME

- Euploidy (normal)
- Aneuploidy (Abnormal)
  - Monosomy
    - lost 1 chromosome
  - Trisomy
    - 3 chromosome
  - non-dysjunction of chromosomes

EFFECTS

AUTOSOMAL
- development problems
- lethal (monosomy)

SEX CHROMOSOMES
- less severe
- altered sexual characteristics
- reduced fertility
- X monosomy (mares)
  - → small vulva, uterus etc.
  - → sporadic periods of oestrus behaviour
- Rare XXY trisomy (bull)
  - → High testosterone in blood
  - → small scrotum size + testes

STRUCTURAL CHANGES

- by mistakes in meiotic recombination
- by DNA break/repairs

Unbalanced changes
- overall loss or gain of total amount of DNA

Balanced changes:
- no overall change of DNA content although gene neighbourhood is affected and may alter gene expression

Change	Description	Balanced or Unbalanced	Effect
Inversion	Segment of chromosome breaks in 2 places, fragment inverts, rejoins	Balanced · Not losing or gaining any chromosome	Likely none. Gene neighbourhood changed so possibly gene expression changes.
Translocation	Chromosomal segment moves from one chromosome to a non-homologous chromosome		Translocations can cause reduced fertility
Deletion	Chromosome breaks in two places and fragment lost before rejoining	Unbalanced	Where large segments involved, usually lethal or severe malformation or infertility.
Duplication	A segment of the chromosome is duplicated		Small areas no or less effect ("copy number variants" or CNV)

→ lead to new function or lethal loss of function

→ crossing over
- normal event, spontaneous event
- Abnormal if compared to rest of population

Translocation

- **Reciprocal**: segments exchange btw 2 non-homologous chromosomes
  - → btw chr 11 and 15
  - → functional but unbalanced gametes
  - → zygotes die
- **Centric fusion**: 2 acrocentric fuse to form 1 metacentric chromosome
  - → Balanced: short arms + correct DNA copy = little to few clinical signs
  - → Unbalanced: sterility, infertility
- **Tandem**: part of arm breaks off and joins to other arm of another chromosome

LOSS OF DOUBLE CHROMOSOME

- Haploidy - 1 set (gametes)
- Diploidy - normal 2 sets in somatic cells
- Triploidy - 3 sets
- Tetraploidy - 4 sets
- Polyploidy - more than 2 sets

EFFECTS OF POLYPLOIDY

- lethal in mammals at foetal/embryonic stage
- development abnormalities
- stillborn
- gross anatomic abnormalities