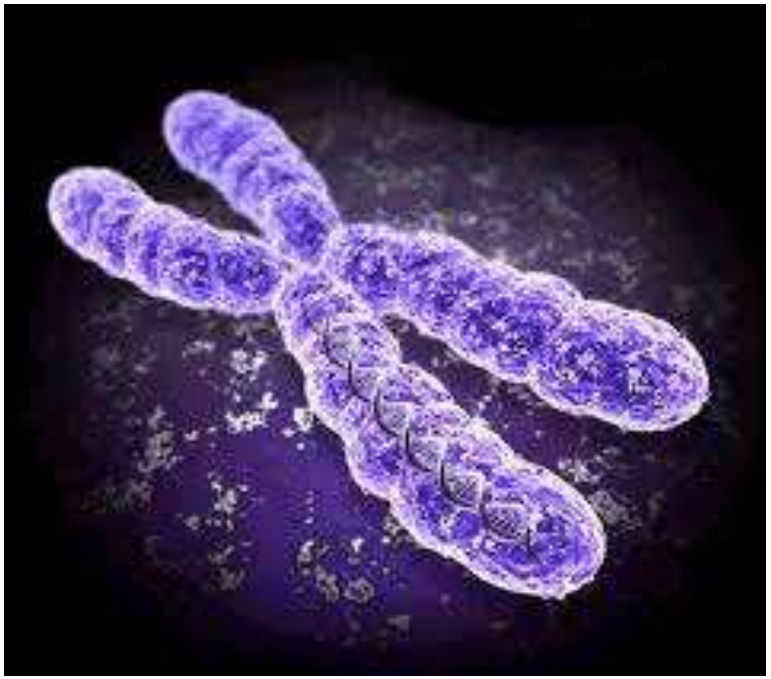
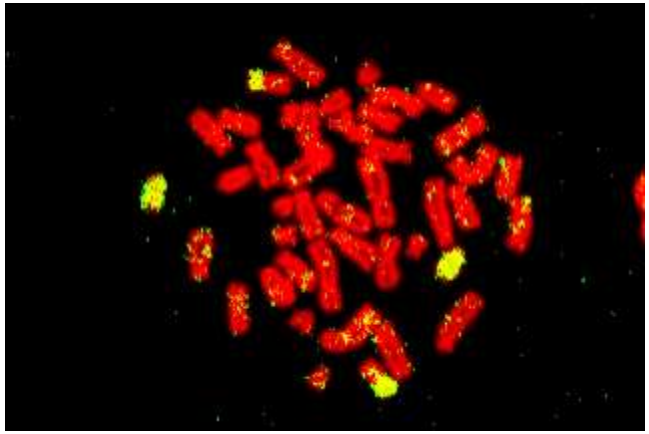


- *The Chromosomal Basis of Inheritance*

# The Chromosomal Theory of Inheritance

- Genes have specific loci on chromosomes and chromosomes undergo segregation and independent assortment

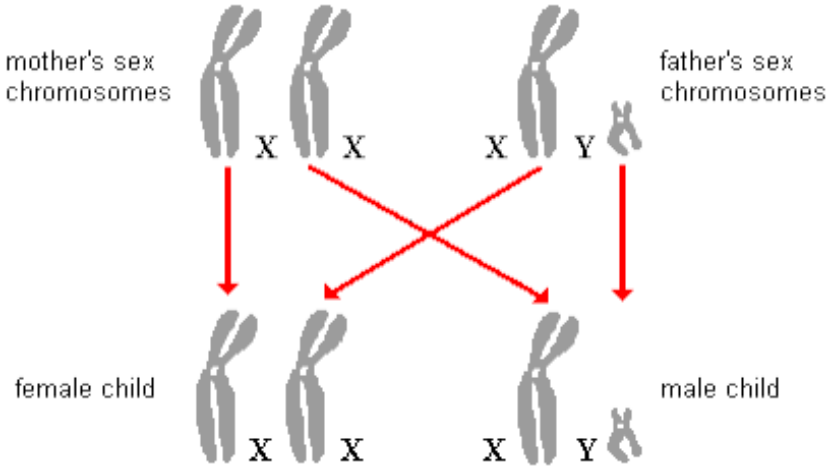


# Chromosomal Linkage

- Morgan
- *Drosophilia melanogaster*

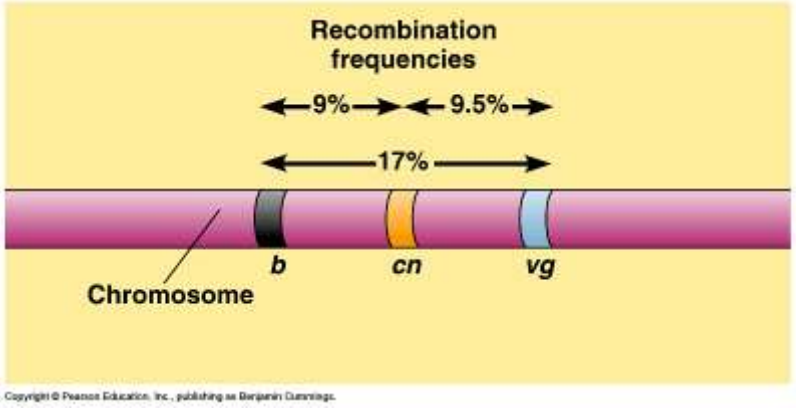
a

- Linked genes: genes located on the same chromosome that tend to be inherited together



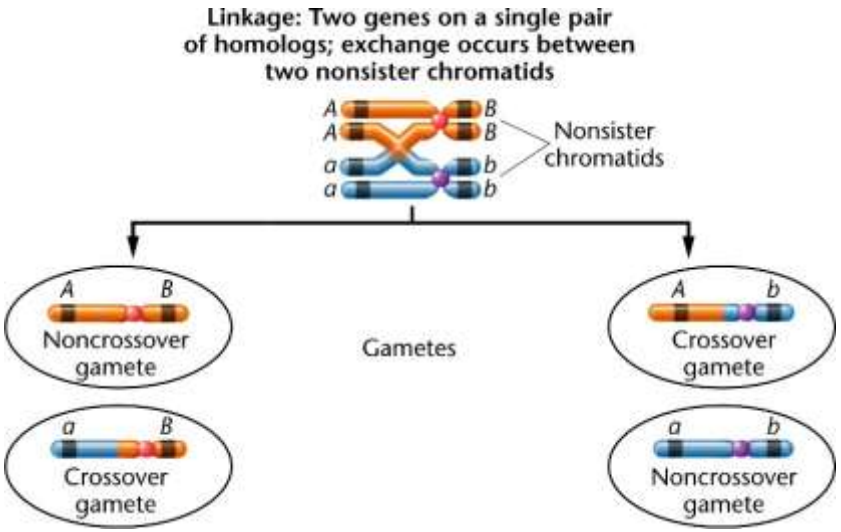
# Genetic recombination

- **Crossing over**
  Allows genes to assort independently
- **Genetic maps**
  The further apart 2 genes are, the higher the probability that a crossover will occur between them and therefore the higher the recombination frequency
- **Linkage maps**
  Genetic map based on recombination frequencies



# Gene Mapping

- If traits assort independently, they will follow patterns predicted in a Punnett Square.
- Linked genes are more likely to be found together because they are carried together on the same chromosome



# Practice Problem

- Parents: **NnPp x nnpp**
- **Use a Punnett square to predict the Expected number of offspring out of 1000.**
- **If your data shows: NP = 400, np = 400, Np = 100 and nP = 100, use a chi square to determine whether your expected data matches these observations**

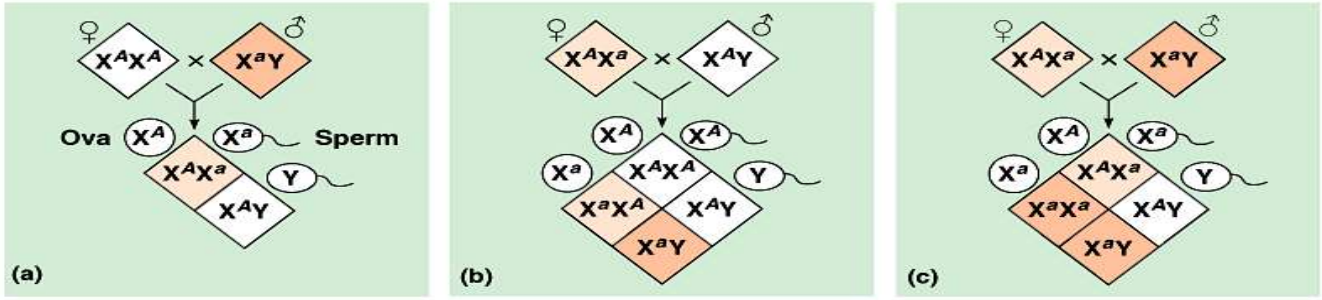
- Sturtevant, an undergrad student of Morgan's (21 old), invented a way to quantify the relationship between the rate of recombination and the distance between genes.

$$\frac{\text{\# recombinants}}{\text{\# total}} = \text{(RF=Recombination Frequency)}$$

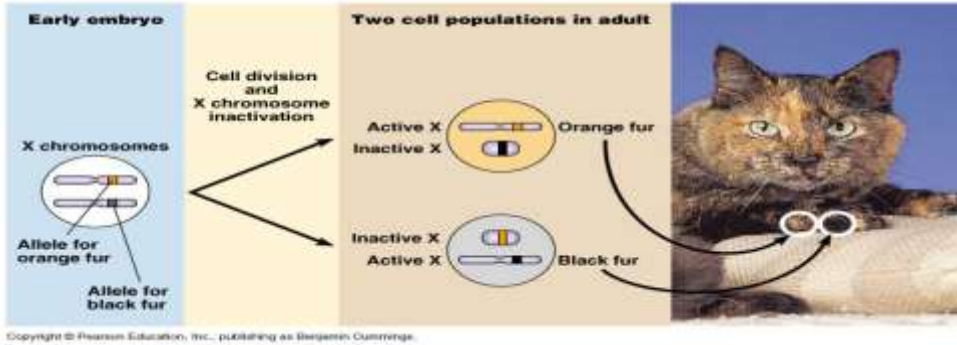
- RF X 100 = = % recombination recombination
- 1%  recombination = 1 map unit(mu)
- = 1 cM (centiMorgan)

# Human sex-linkage

- **SRY gene: gene on Y chromosome that triggers the development of testes**
- **Fathers= pass X-linked alleles to all daughters only (but not to sons)**
- **Mothers= pass X-linked alleles to both sons & daughters**
- **Sex-Linked Disorders: Color-blindness; Duchenne muscular dystropy (MD); hemophilia**
- **X-inactivation: 2nd X chromosome in females condenses into a Barr body (e.g., tortoiseshell gene in cats)**

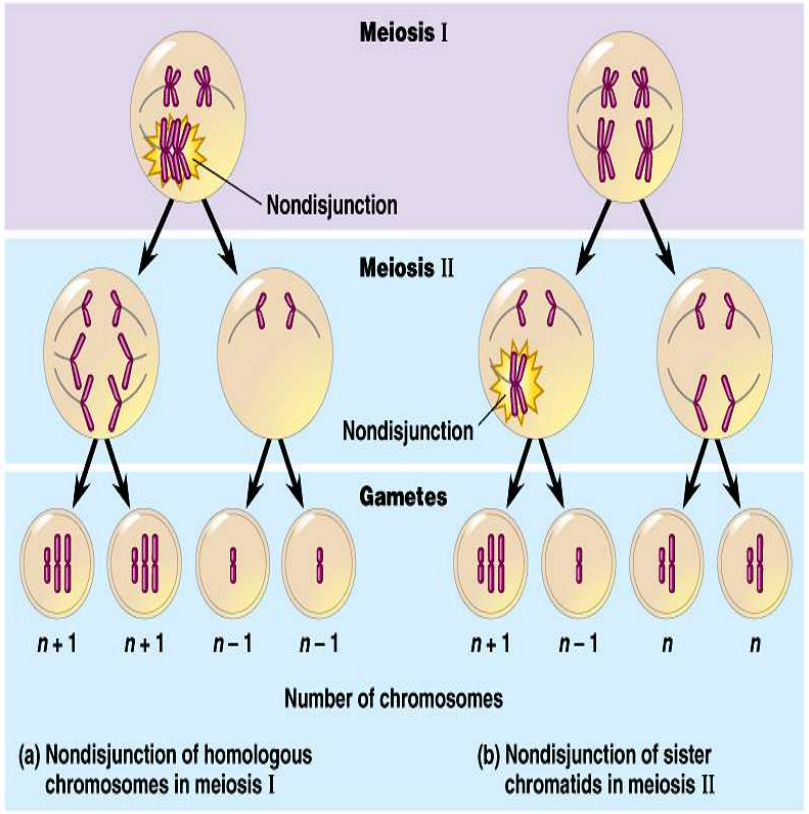




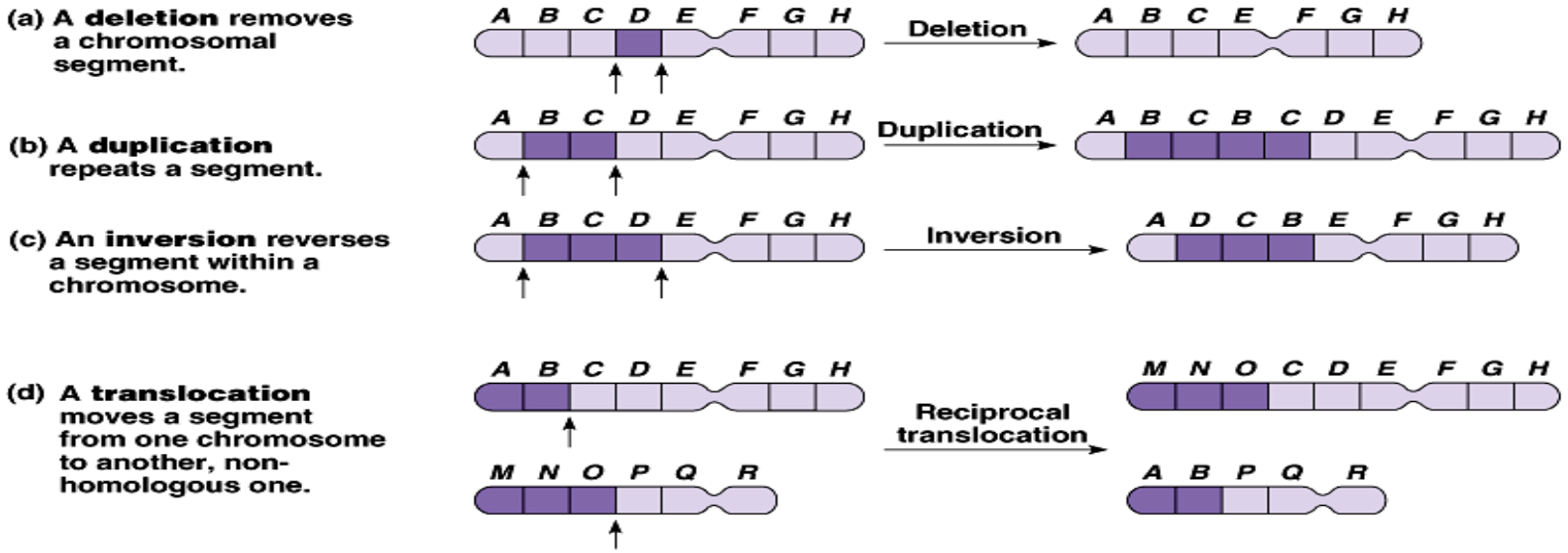
# Chromosomal errors, I

- Nondisjunction: members of a pair of homologous chromosomes do not separate properly during meiosis I or sister chromatids fail to separate during meiosis II
- Aneuploidy: chromosome number is abnormal
  - Monosomy- missing chromosome
  - Trisomy- extra chromosome (Down syndrome)
  - Polyploidy- extra sets of chromosomes



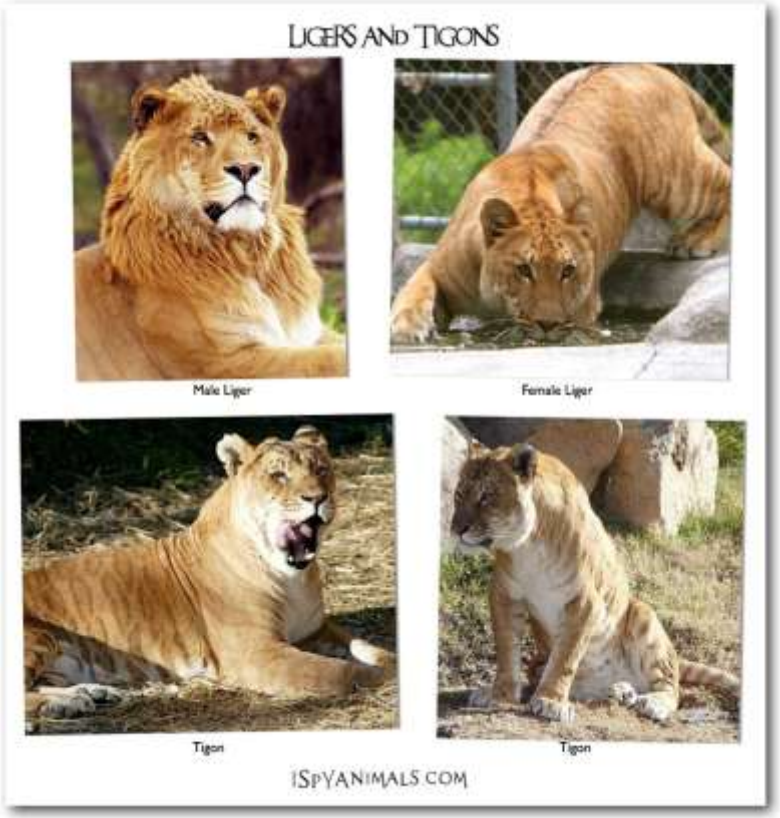
# Chromosomal errors, II

- <u>Alterations of chromosomal structure:</u>
- Deletion: removal of a chromosomal segment
- Duplication: repeats a chromosomal segment
- Inversion: segment reversal in a chromosome
- Translocation: movement of a chromosomal segment to another



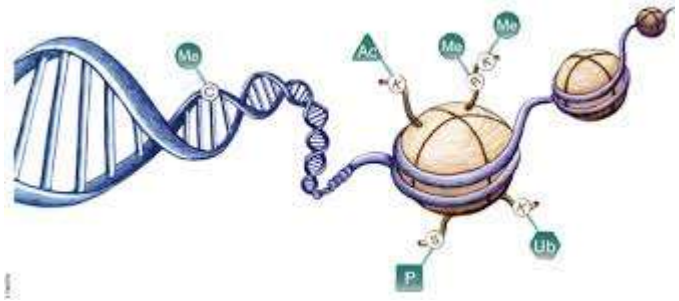
# Genomic imprinting

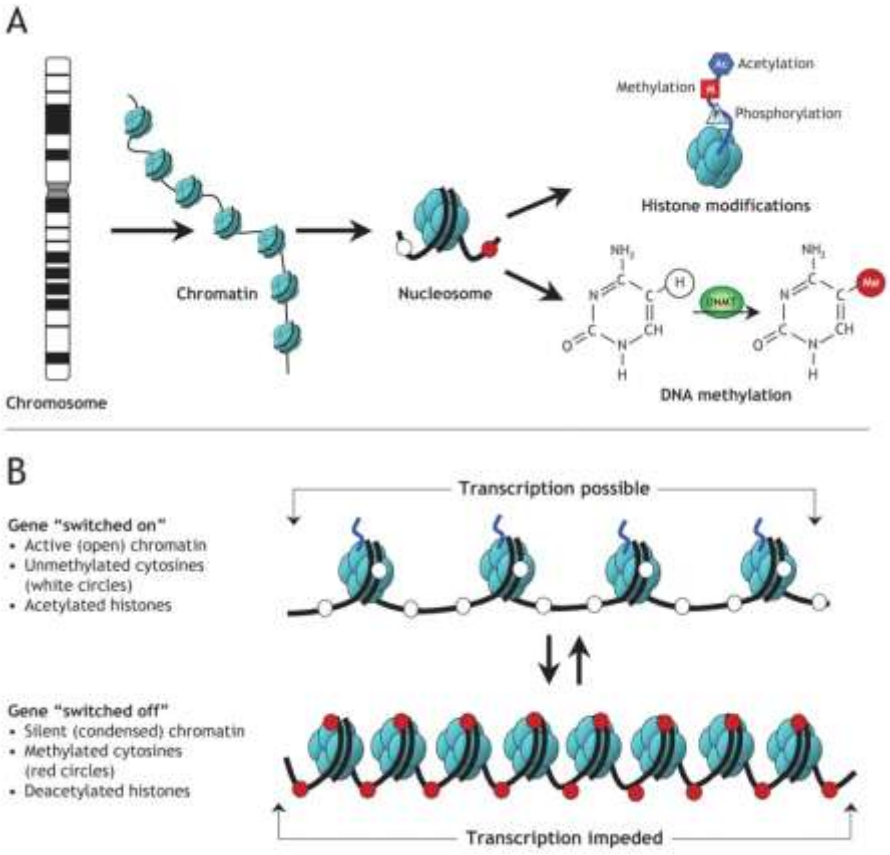
- Def:  a parental effect on gene expression
- Identical alleles may have different effects on offspring, depending on whether they arrive in the zygote via the ovum or via the sperm.
- Expression of genes varies as they are modified during development
- One copy of a gene is silenced by methylation



# Methylation

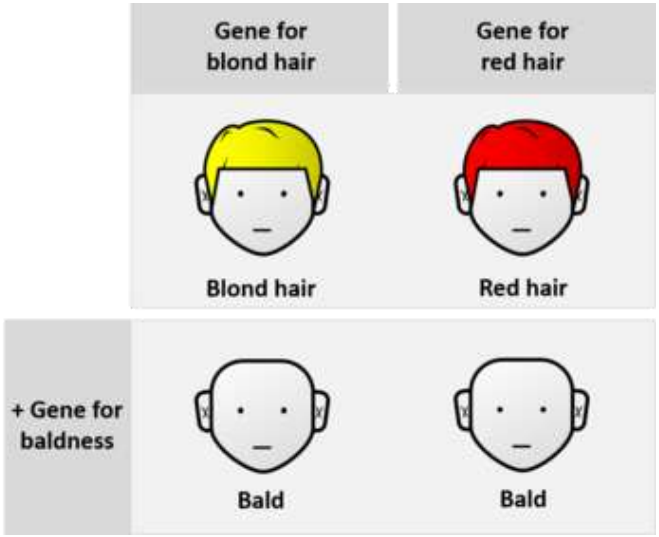
- Genes are silenced by addition of methyl groups to DNA or histones



# Epistasis

- Other genes impact the expression of traits.
- Genes in combination act differently due to background genes
- Genes in identical twins can be expressed differently




# Homeobox Genes

- Regions of the gene carry out similar function in different organism
- These regions have evolved from common ancestors and are homologous