Read the emails you receive from me carefully and completely

Lecture PDF and links will be on Moodle ~24 hours after each Lecture
Lecture recordings will be on Google Drive ~24 hours after each Lecture

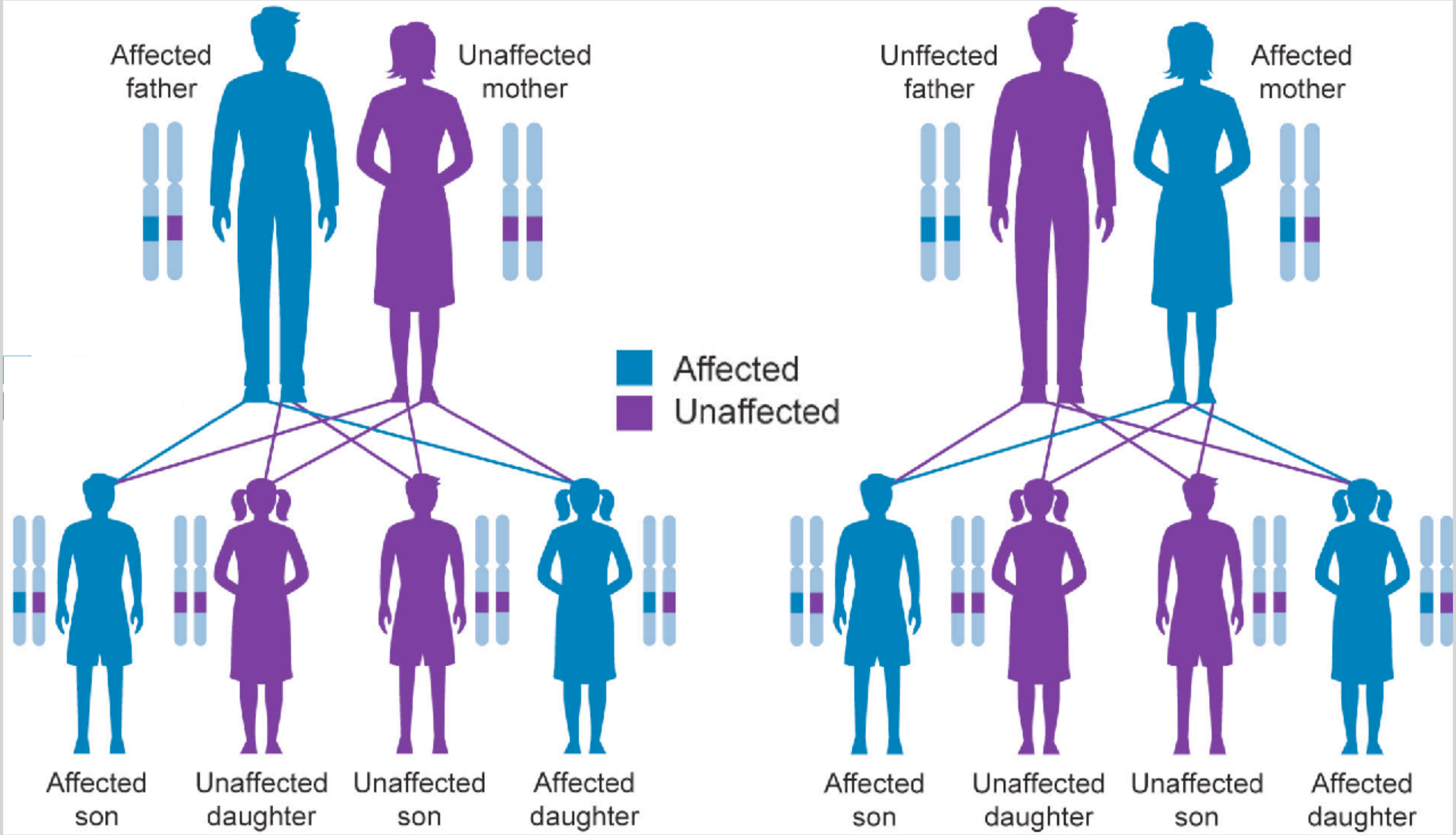
You can access Google Drive using your IITB email credentials ONLY
Access will not be provided for non-IITB email addresses

Campbell Biology Chapter 14: Concepts 14.1 and 14.2
Chapter 15: Concepts 15.1, 15.2 and 15.3
+
Lecture Material
Papers to understand Lecture content which will be part of exam is on Google Drive

Familiarise yourselves with the material with an emphasis on Learning

You are not required to remember details - will not be asked in exam
You are required to understand the concepts - will be in the exam

Dominant inheritance

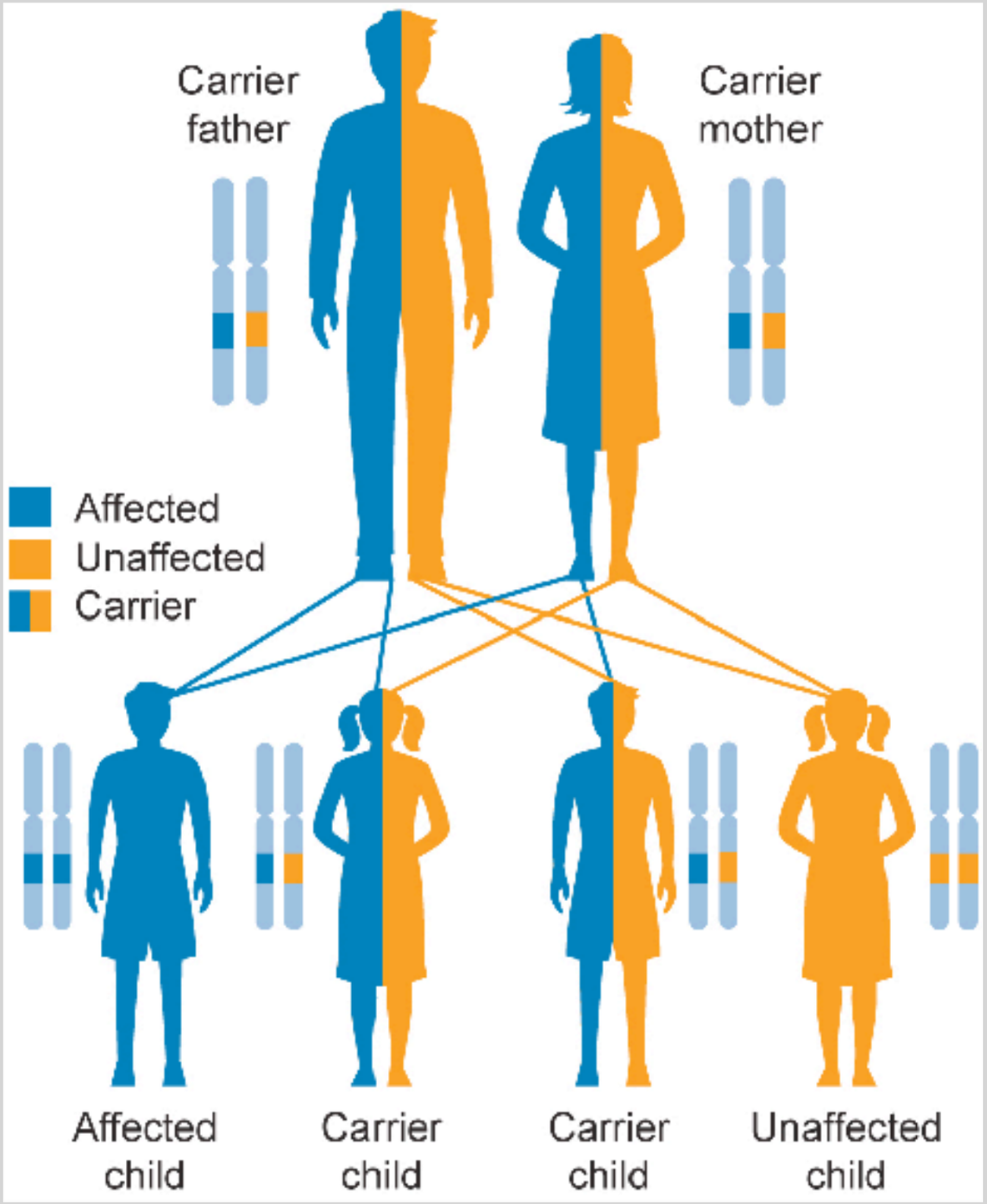


Affects males and females equally

Huntington`s disease
Marfan syndrome
Cardiovascular disorders

Curly hair

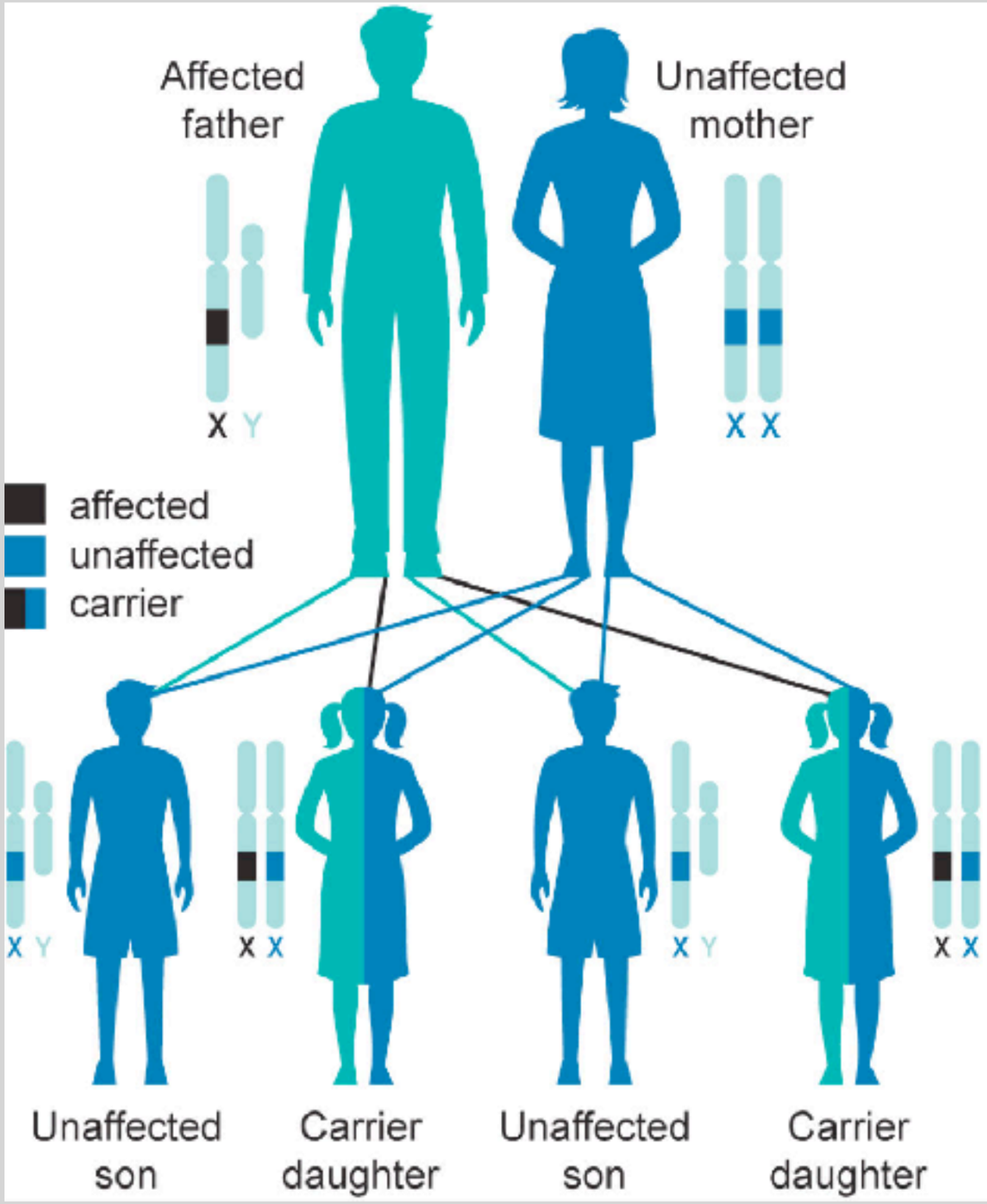
Recessive inheritance

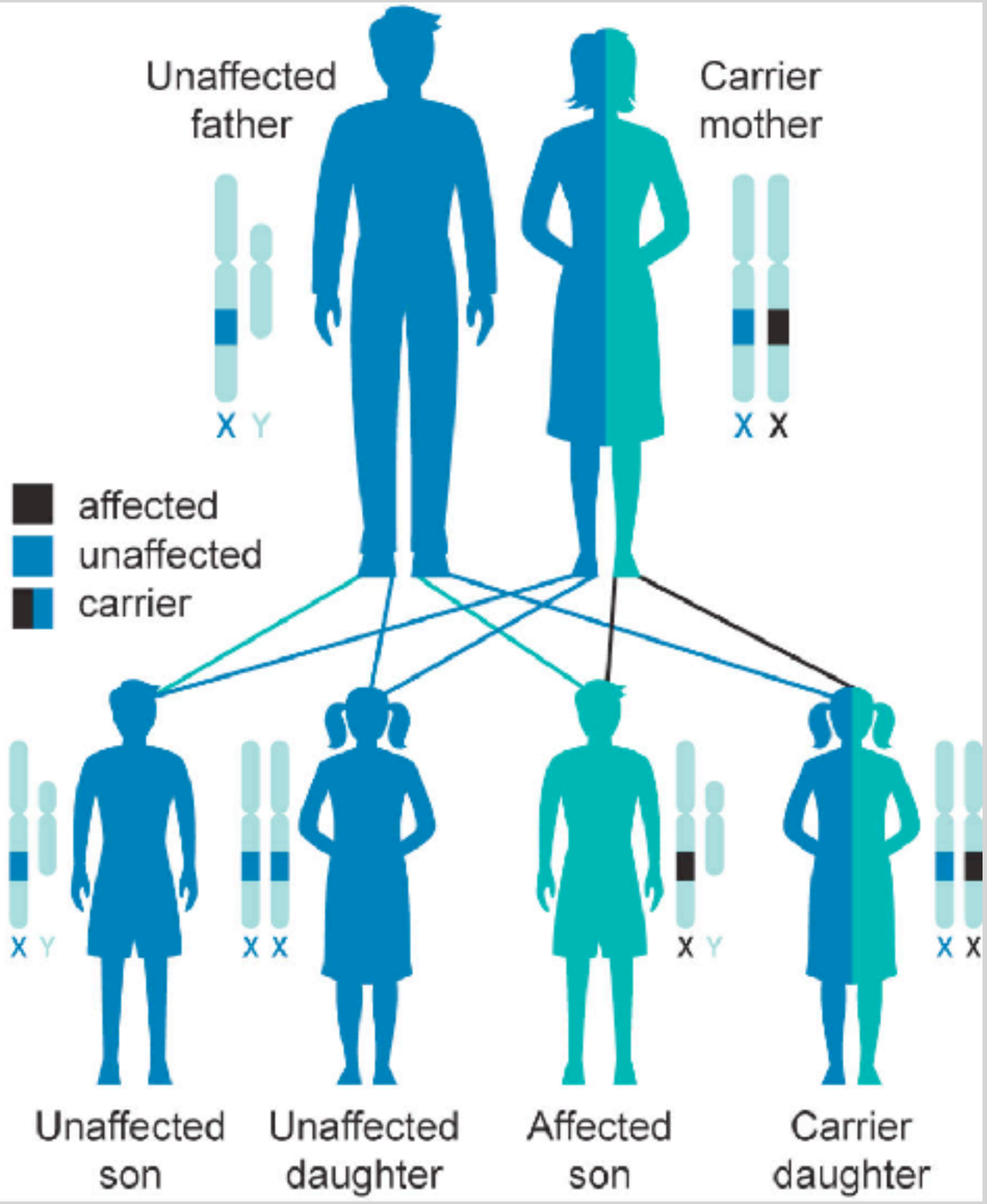


Sickle cell anemia
Albinism
Cystic fibrosis

Affects males and females equally

X-linked inheritance

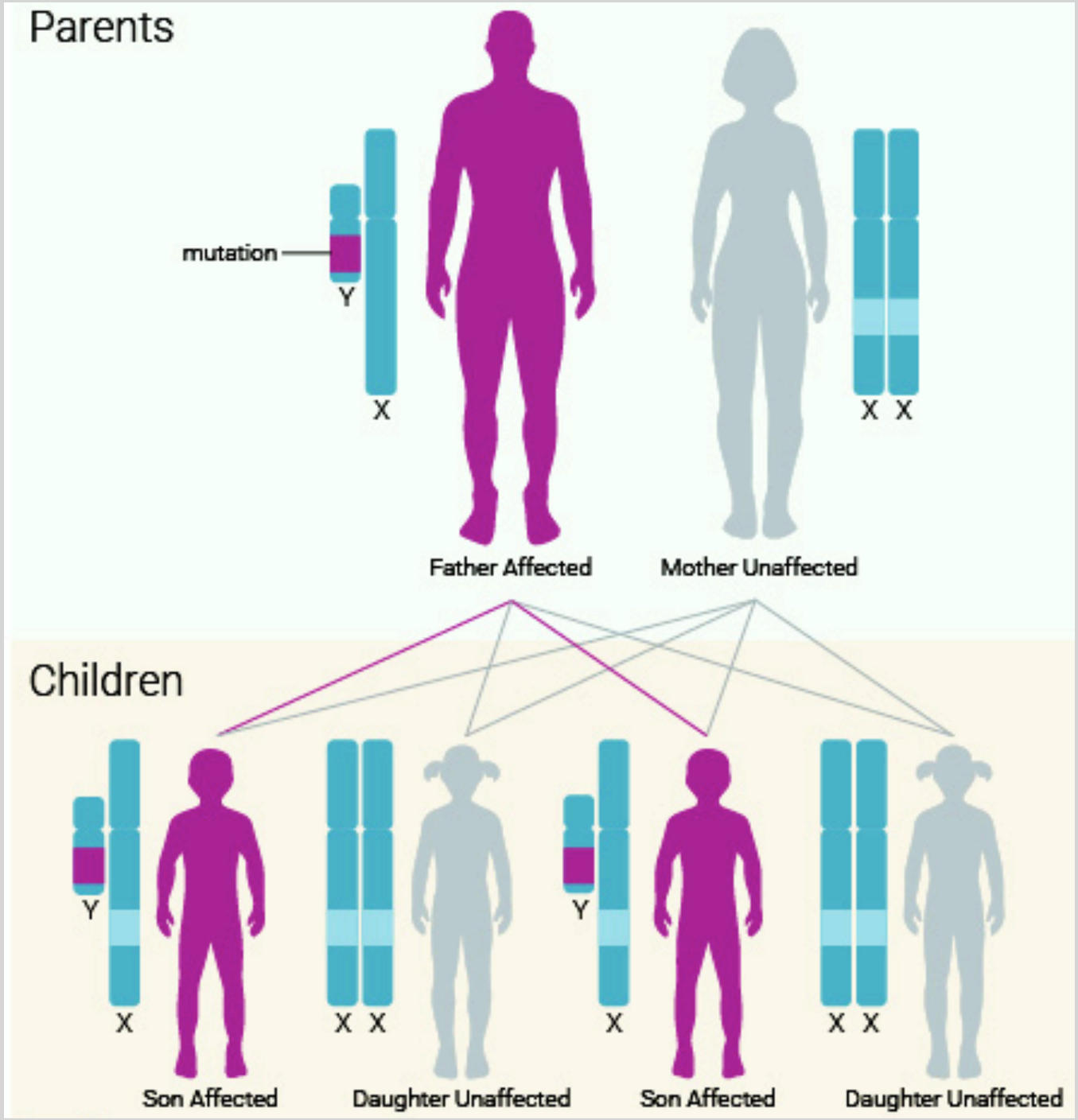




X-linked dominant inheritance - fragile X syndrome

X-linked recessive inheritance - haemophilia, colour blindness, Duchenne Muscular Dystrophy

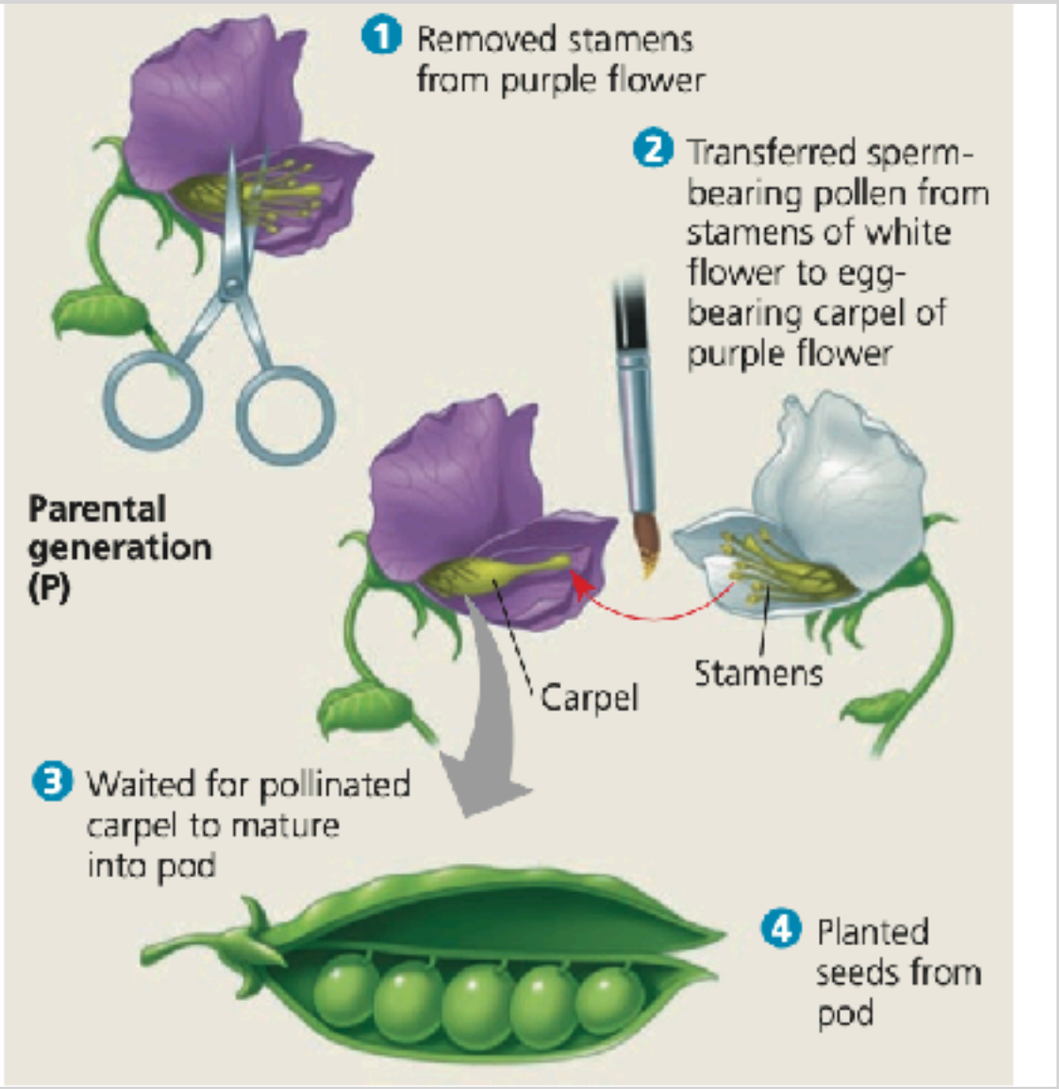
Y-linked inheritance



Y-linked infertility

https://medlineplus.gov/genetics/condition/y-chromosome-infertility/#inheritance

Uncovering universal principles of genetics using pea plants

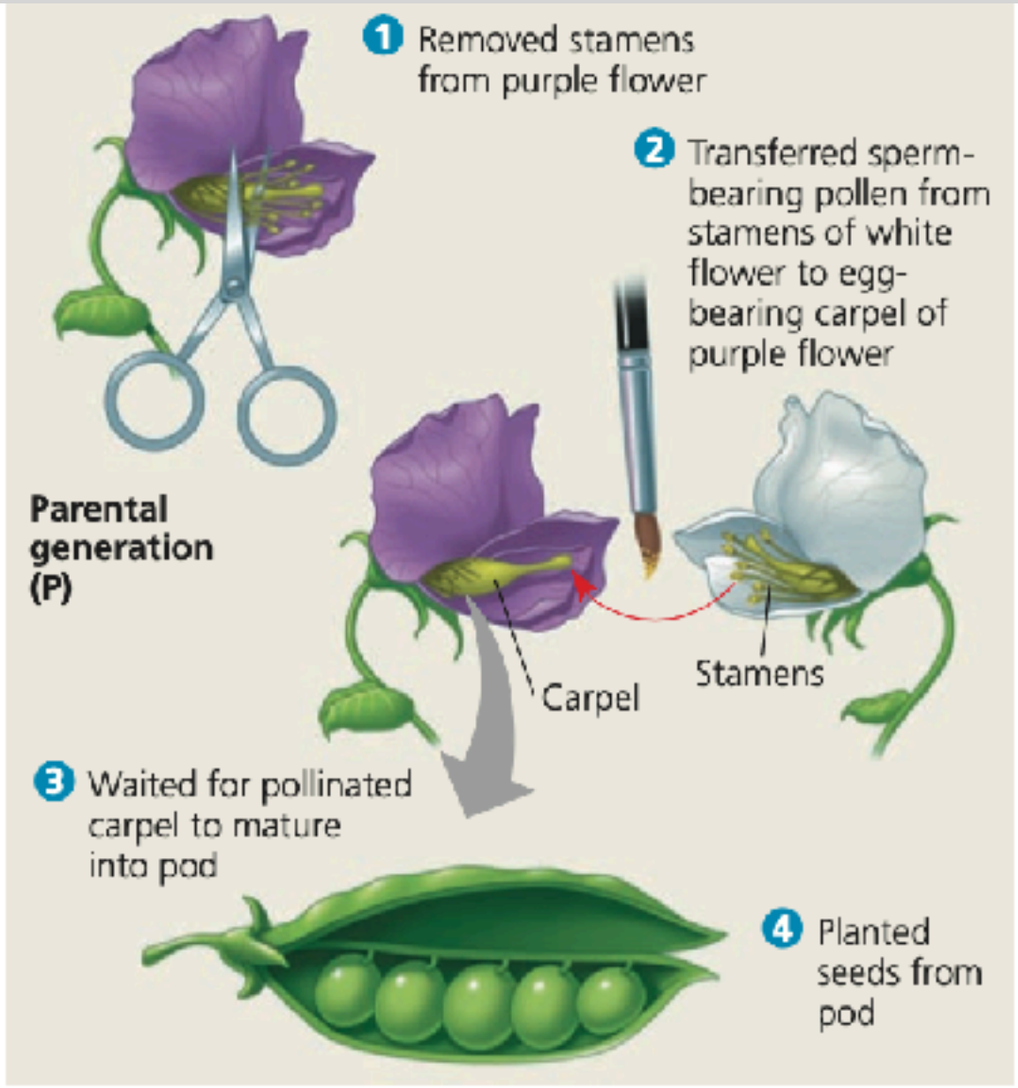


- Pea plants self-fertilise
- One plant has both the stamens (male gamete) and carpel (female gamete)
- Different types of pea plants exist with easily visible differences
- Example: flowers of different colours

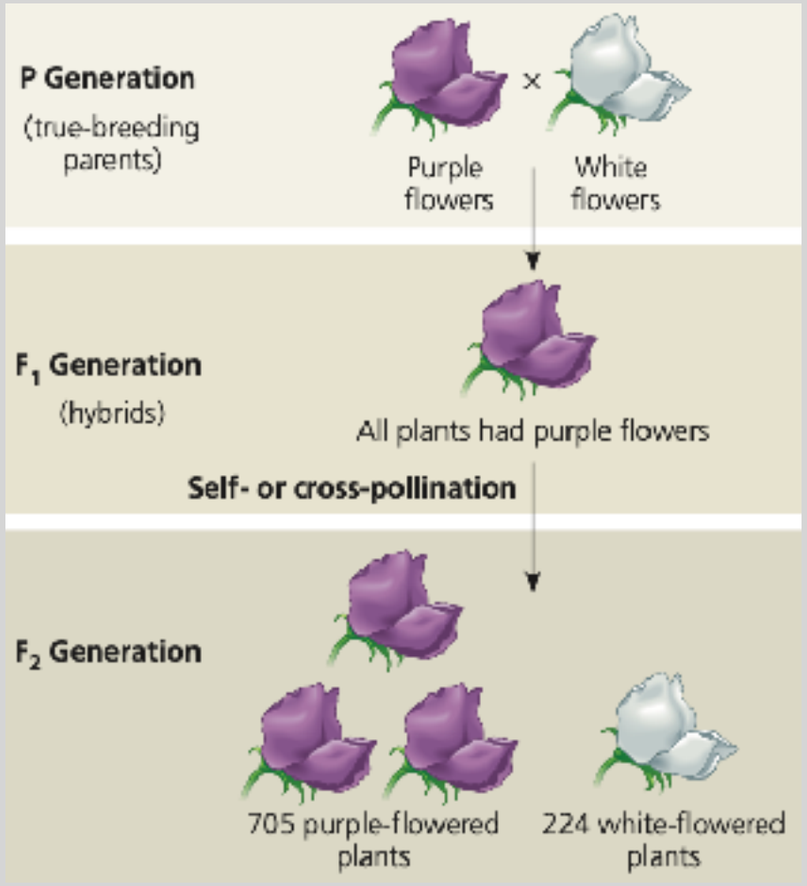
Example:
Flower colour = character
Type of the colour = trait

Hair = Character
Hair colour = trait
Hair curly vs straight vs wavy = trait

Uncovering universal principles of genetics using pea plants



Results When pollen from a white flower was transferred to a purple flower, the first-generation hybrids all had purple flowers. The result was the same for the reciprocal cross, which involved the transfer of pollen from purple flowers to white flowers.



Parents

First Generation =
All purple
White got lost/
hidden

Second Generation =
3:1 Purple to White

Concepts imagined by Mendel which would explain the 3:1 distribution of observed traits

Table 14.1 The Results of Mendel's F_1 Crosses for Seven Characters in Pea Plants

Character	Dominant Trait	×	Recessive Trait	F_2 Generation Dominant: Recessive	Ratio
Flower color	Purple 	×	White 	705:224	3.15:1
Seed color	Yellow 	×	Green 	6,022:2,001	3.01:1
Seed shape	Round 	×	Wrinkled 	5,474:1,850	2.96:1
Pod shape	Inflated 	×	Constricted 	882:299	2.95:1
Pod color	Green 	×	Yellow 	428:152	2.82:1
Flower position	Axial 	×	Terminal 	651:207	3.14:1
Stem length	Tall 	×	Dwarf 	787:277	2.84:1

alternative versions of genes account for variations in inherited characters

If a species is diploid, then two versions of a gene can exist in that species

Example: gene for flower colour - exists in two versions in a diploid pea plant - Purple version or White version - flower colour depends on which version is present in the plant

for each character, the plant inherits two versions - one from each parent.

If both versions are the same, then any one of the trait emerges

If both versions are different, then the trait controlled by the dominant version emerges

the two versions physically separate from each other when male and female gametes are formed -

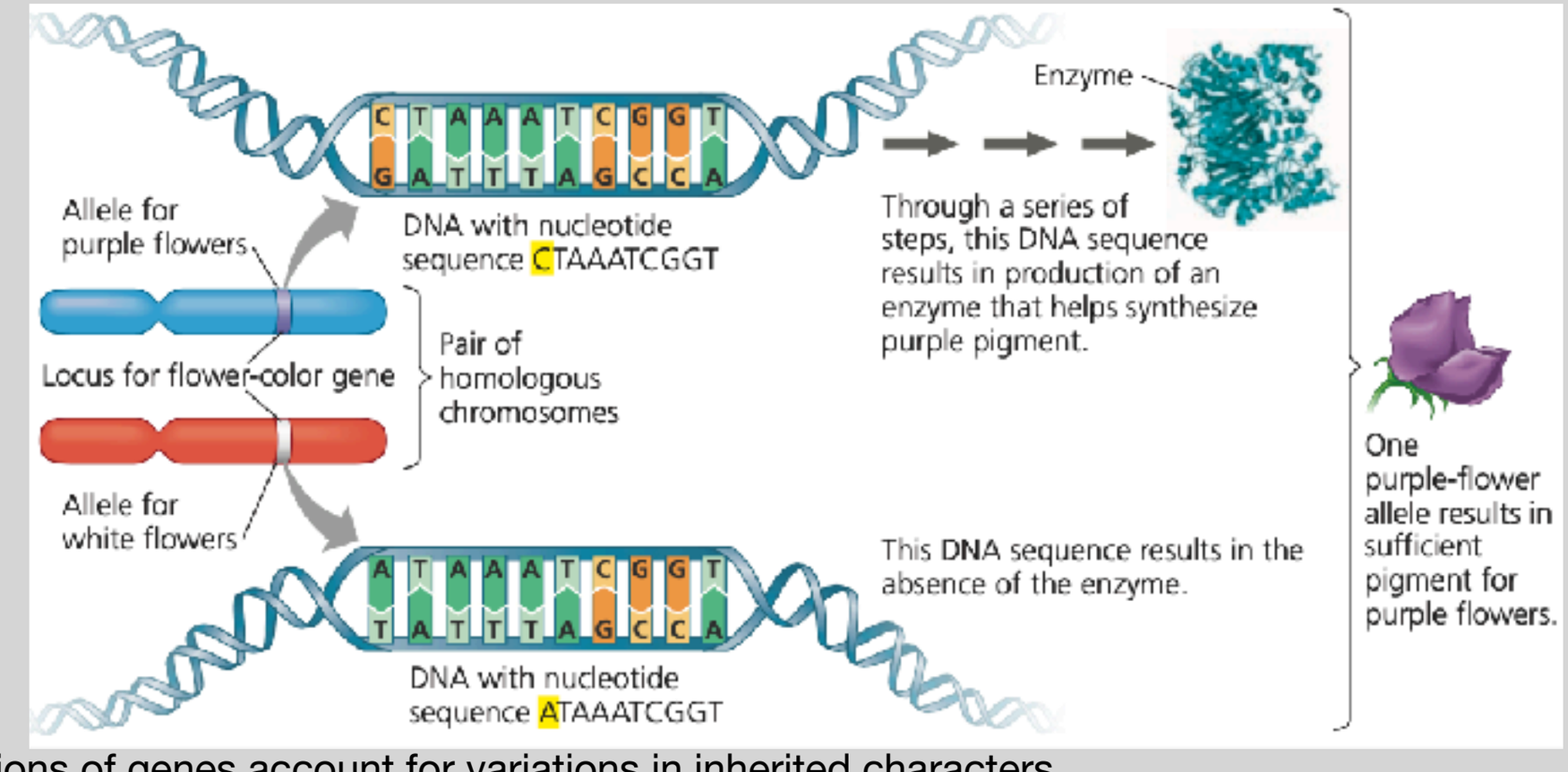
Multiple gametes are produced

Each gamete carries one version

when the versions meet again in the embryo then they pair up in a predictable manner based on how many copies of a version are allowed in that species

Example: if a species is diploid, then two versions can be allowed in that species

Mendel imagined these concepts before genes, chromosomes, DNA etc were discovered



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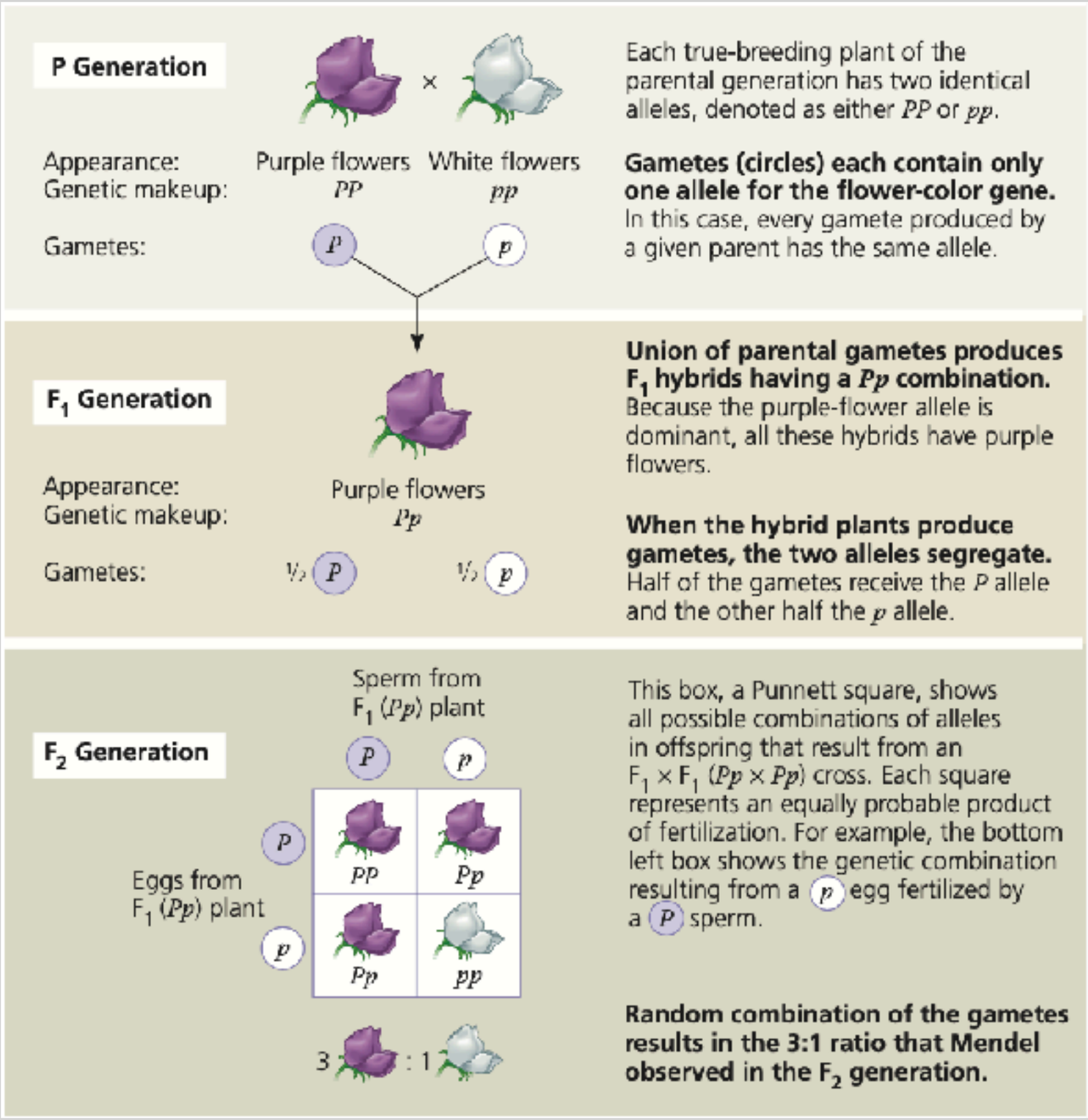
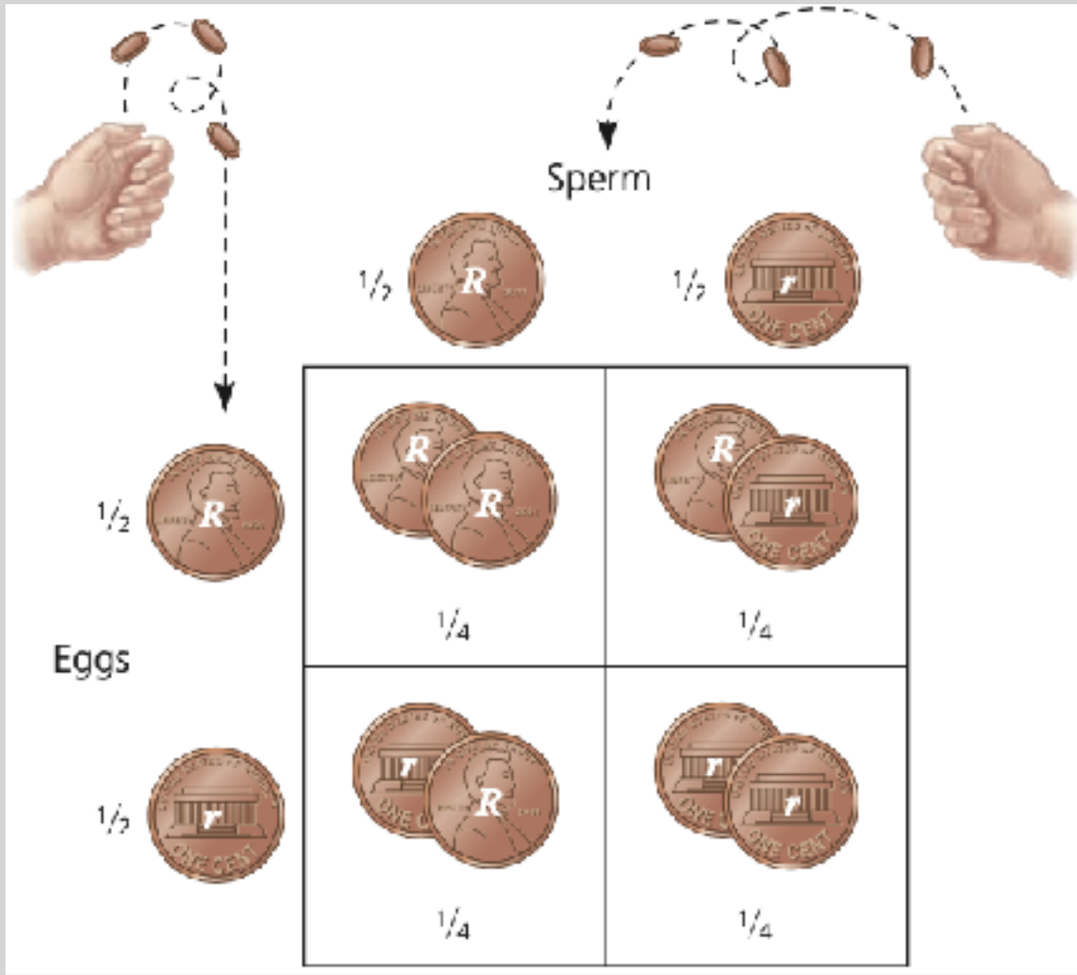
Genetics is Mathematics disguised as Biology

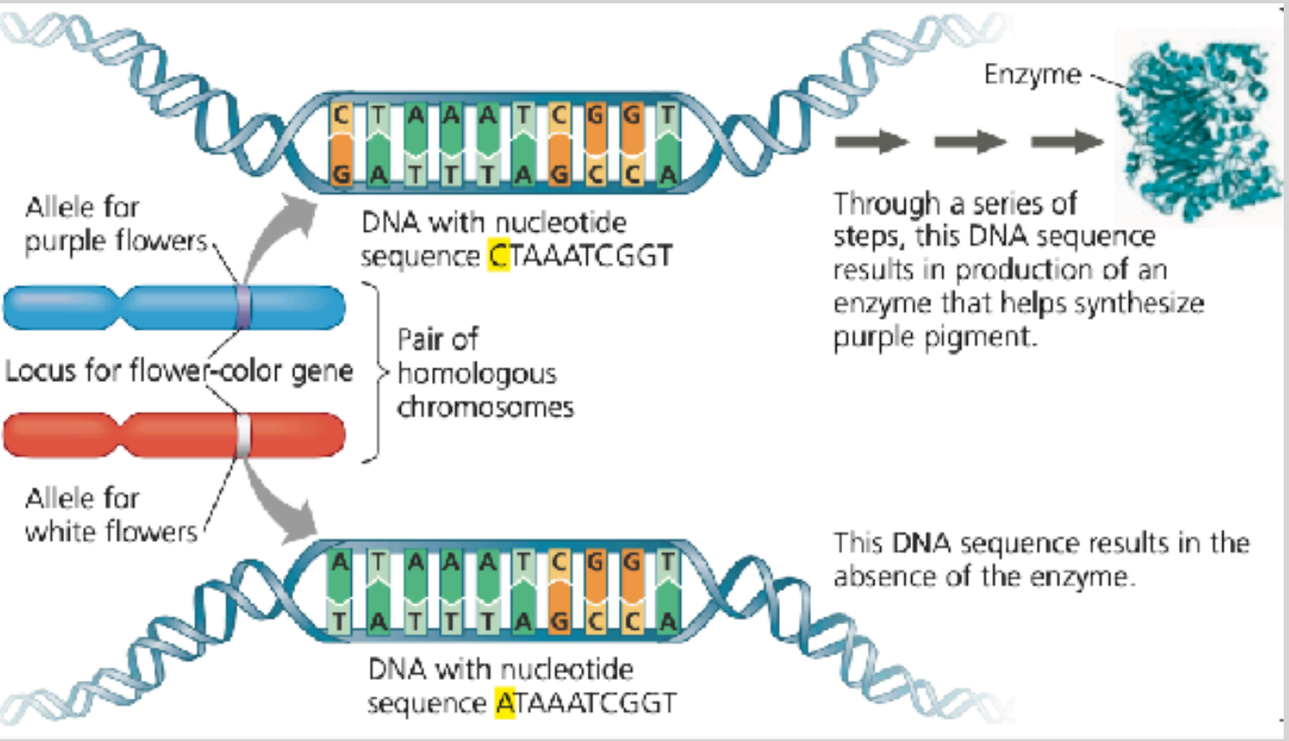


Genotype = Is there one version (haploid) or two versions (diploid) in a cell (P, p, PP, pp or Pp)

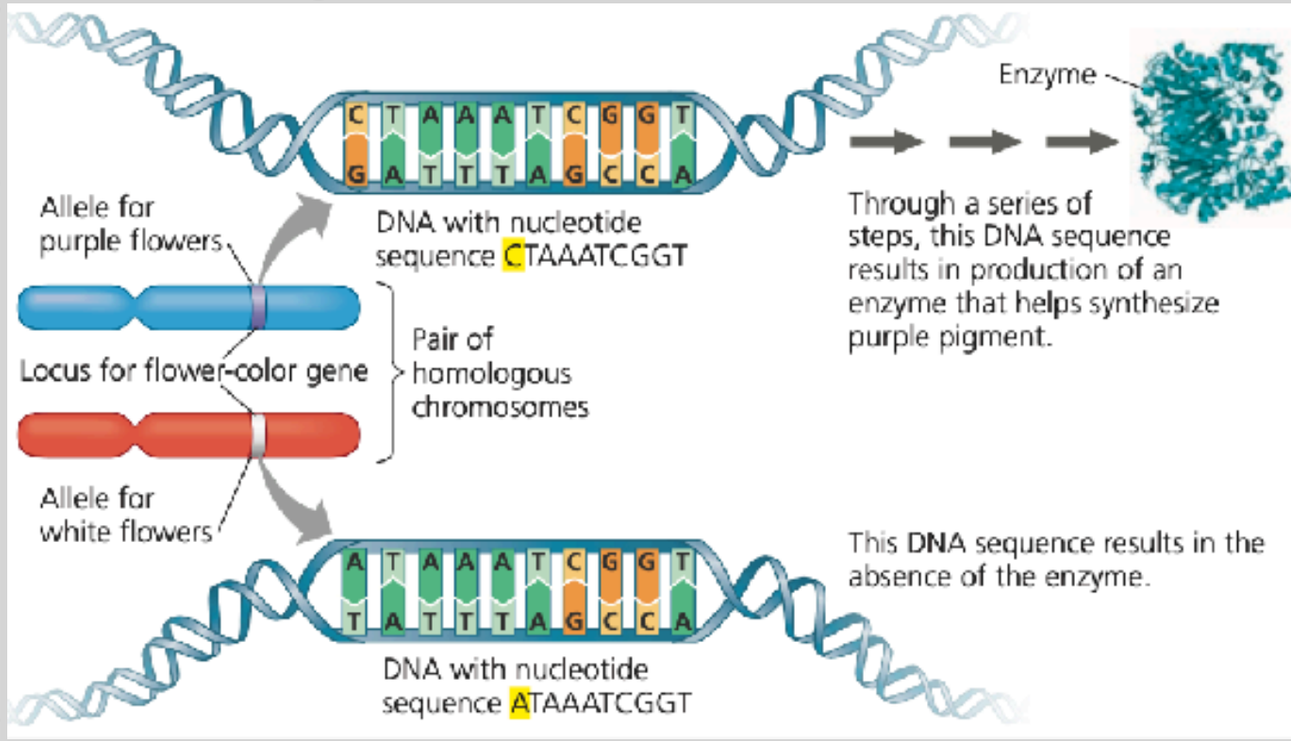
- Most cells in an organism have two versions = diploid
- All gametes have one version = haploid
- Two haploid gametes combine to form an embryo at fertilization = two versions come together in an embryo



Animals and plants have more than one chromosome and many many genes.
What is the relationship between events that happen for different chromosomes and for different genes?



Gene 1 for trait 1



Gene 2 for trait 2

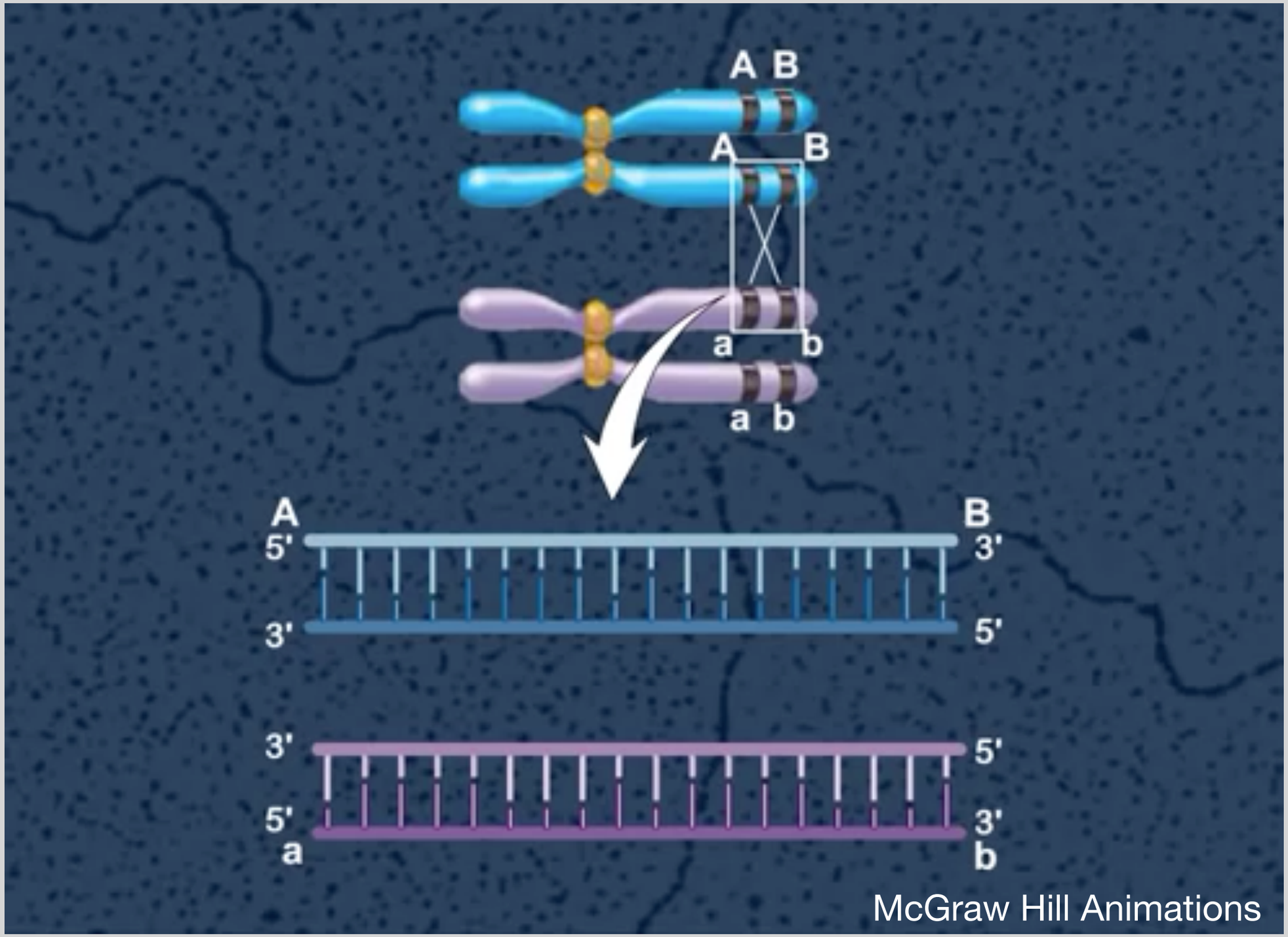
Inheritance of genes on two different chromosomes are completely independent events -
you can toss 100 coins together and all 100 coin tosses are independent events

Inheritance of genes on the same chromosomes separated by a large distance are completely independent events -
INDEPENDANT ASSORTMENT

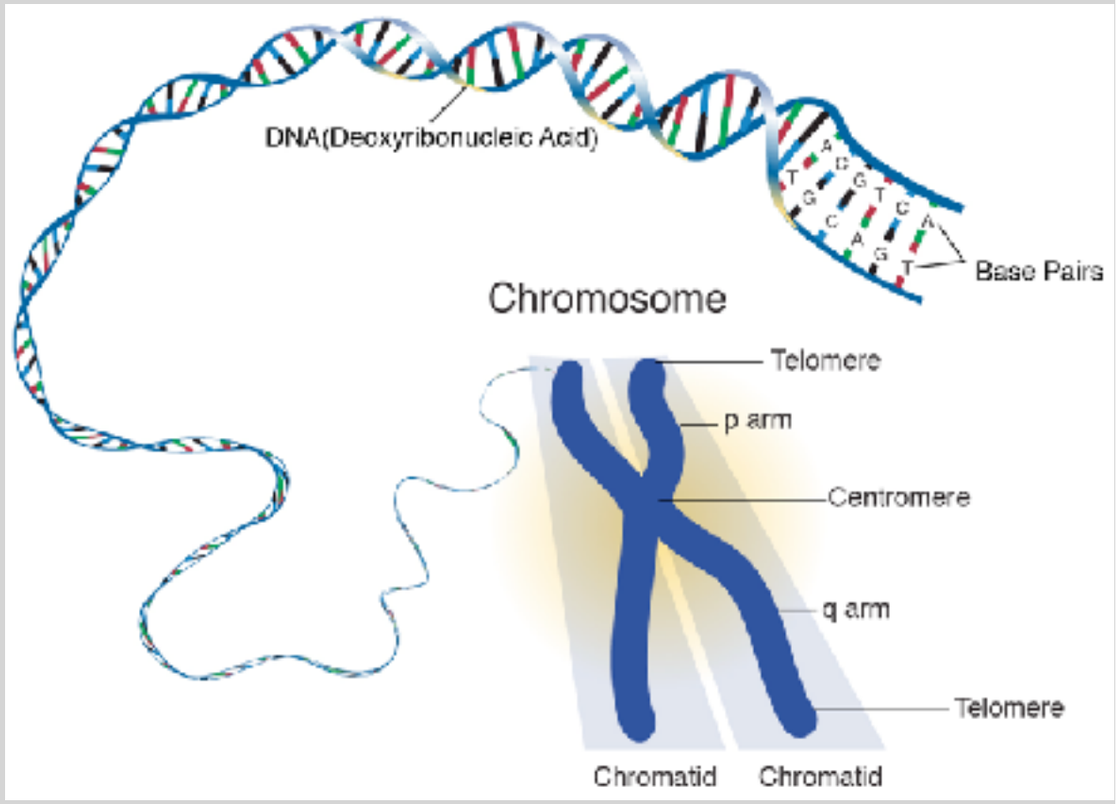
Inheritance of genes on the same chromosomes separated by a small distance are dependent events -
LINKAGE

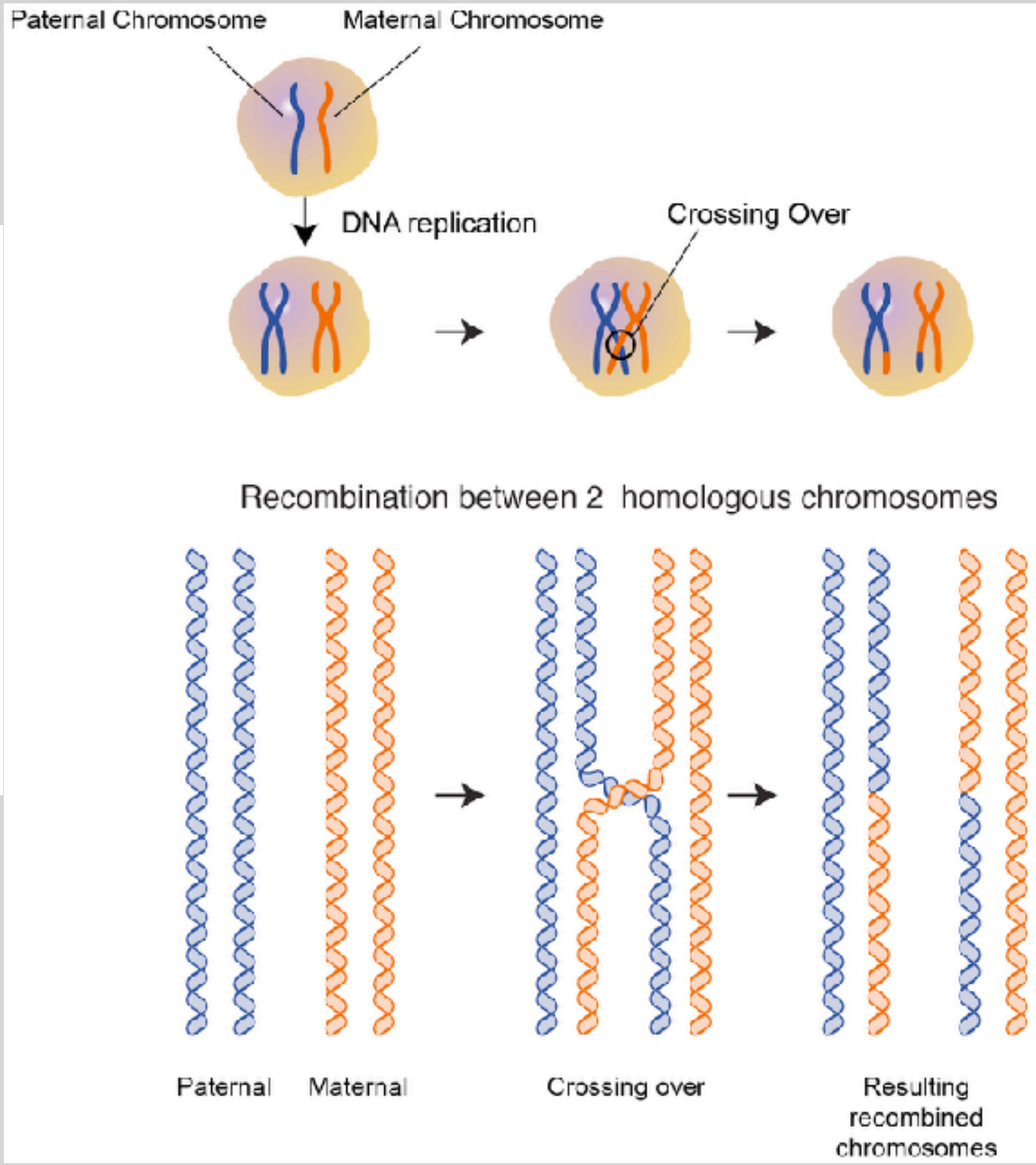
Exchange of DNA between sister chromatids occurs during meiosis

- This phenomenon is known as recombination
- Occurs in all species when sperm and eggs are produced
- Basis of genetic diversity amongst individuals of a species



Understanding the fundamental importance of recombination in the context of gene positions on a chromosome

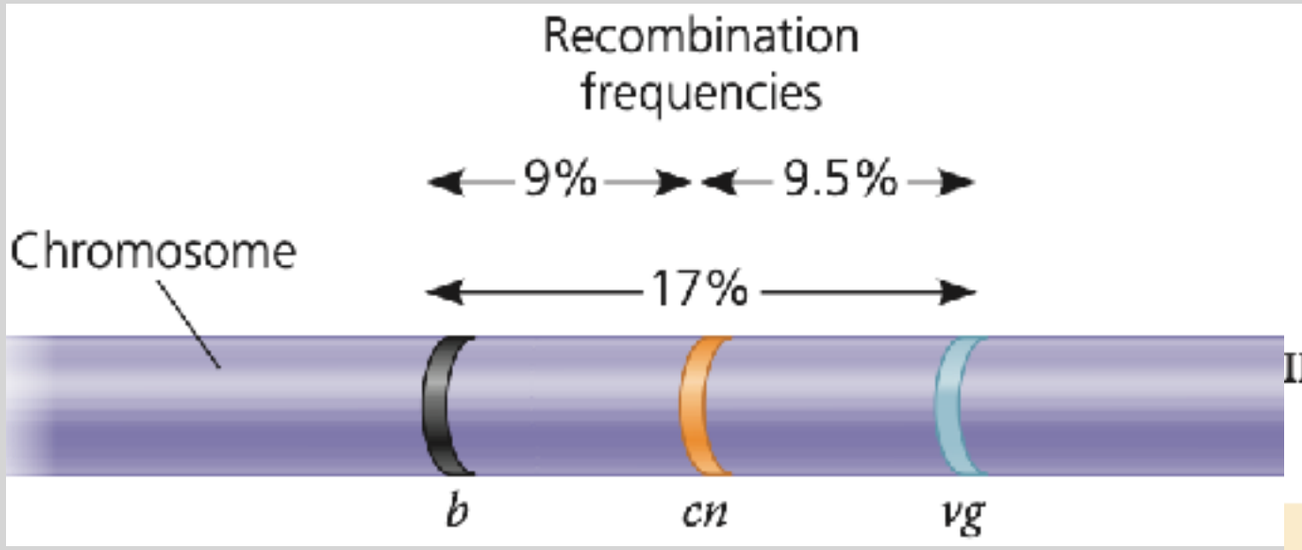




https://www.nature.com/scitable/topicpage/mitosis-14046258/

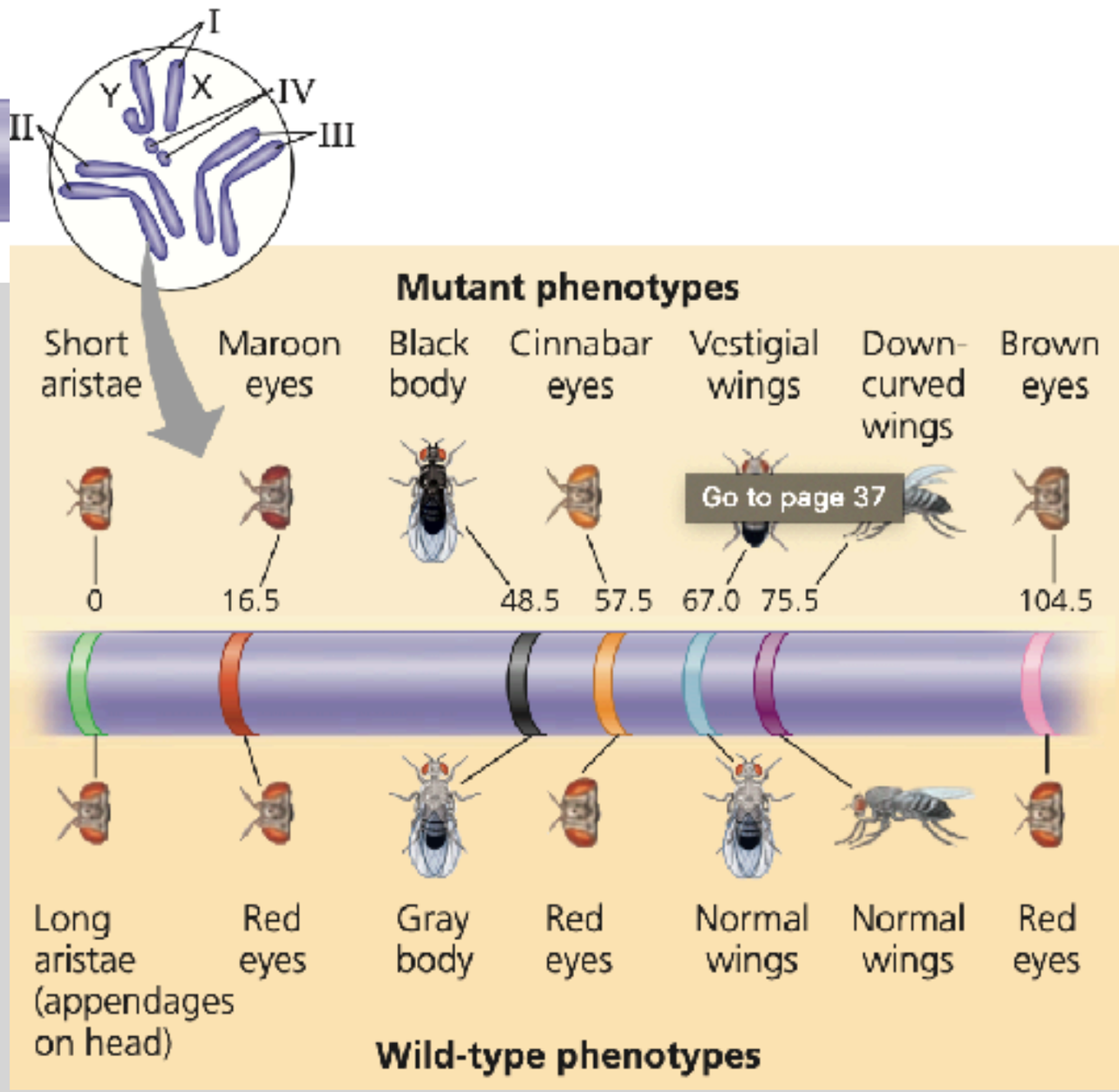
If a cross between two individuals produced 100 progeny, in how many of these progeny do two traits manifest together?

Typically if traits are separated in 1 out of 100 progeny (1%), then the genes controlling those traits are 1centimorgan (cM) apart



https://www.genome.gov/

How does one estimate the distances between genes on human chromosomes?



Inheritance of genes on the same chromosomes separated by a large distance are completely independent events -

INDEPENDANT ASSORTMENT

The probability of which is predictable based on number of versions that are allowed to exist in a species