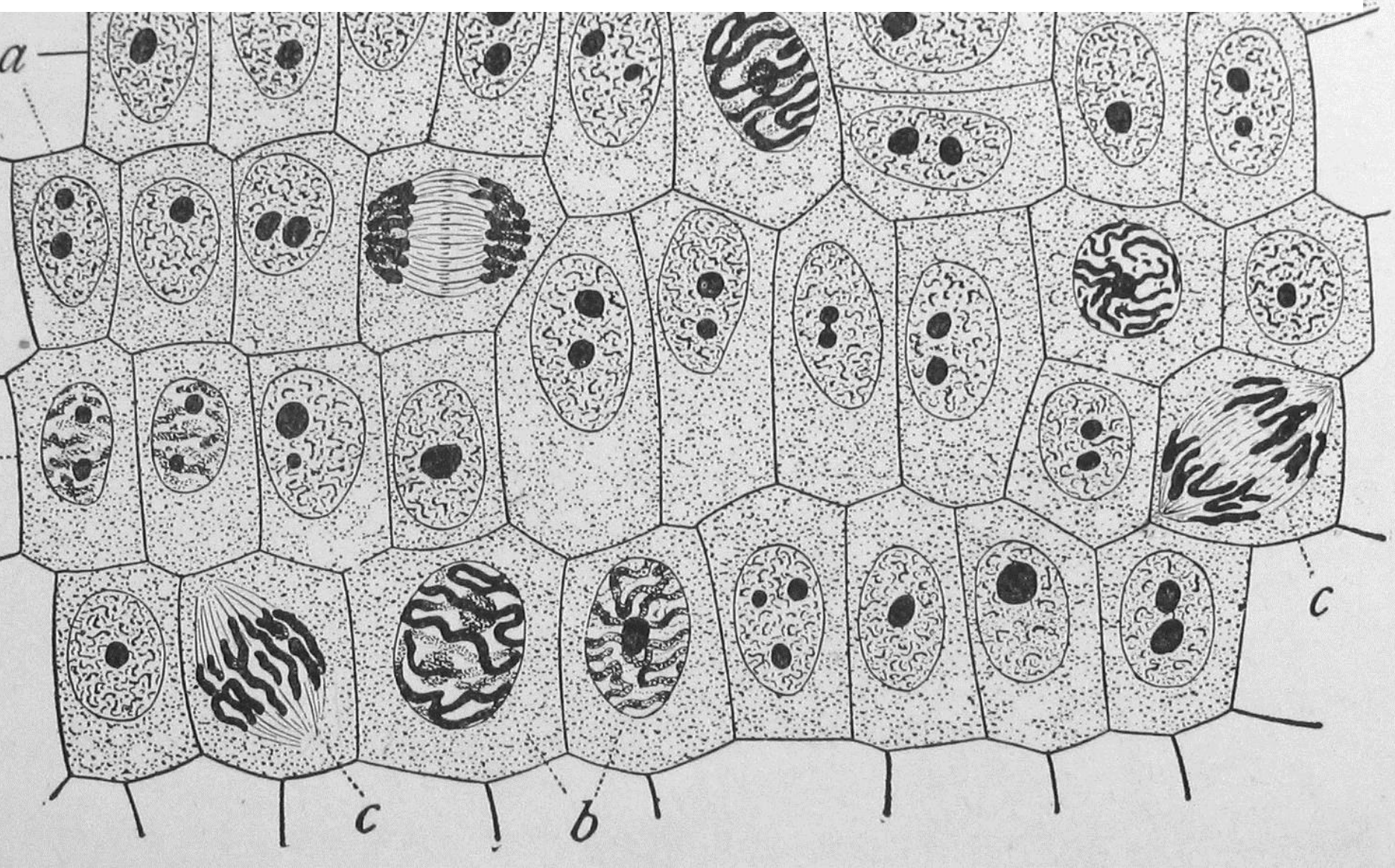
4.3: The chromosomal basis of inheritance provides an understanding of the pattern of passage (transmission) of genes from parent to offspring.

1. Mendelian Genetics

The behavior of chromosomes during the cell cycle allows for heritability



Gregor Mendel

Determined how to analyze genetics from a scientific, mathematical perspective.
Worked with pea plants.

Genotype vs. Phenotype

Genotype: The alleles that an organism has.

BB

Homozygous

Dominant

Bb

Heterozygous

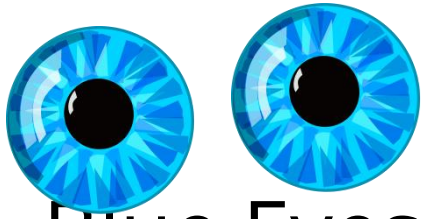
bb

Homozygous

Recessive

Phenotype: the trait an organism shows

Brown eyes



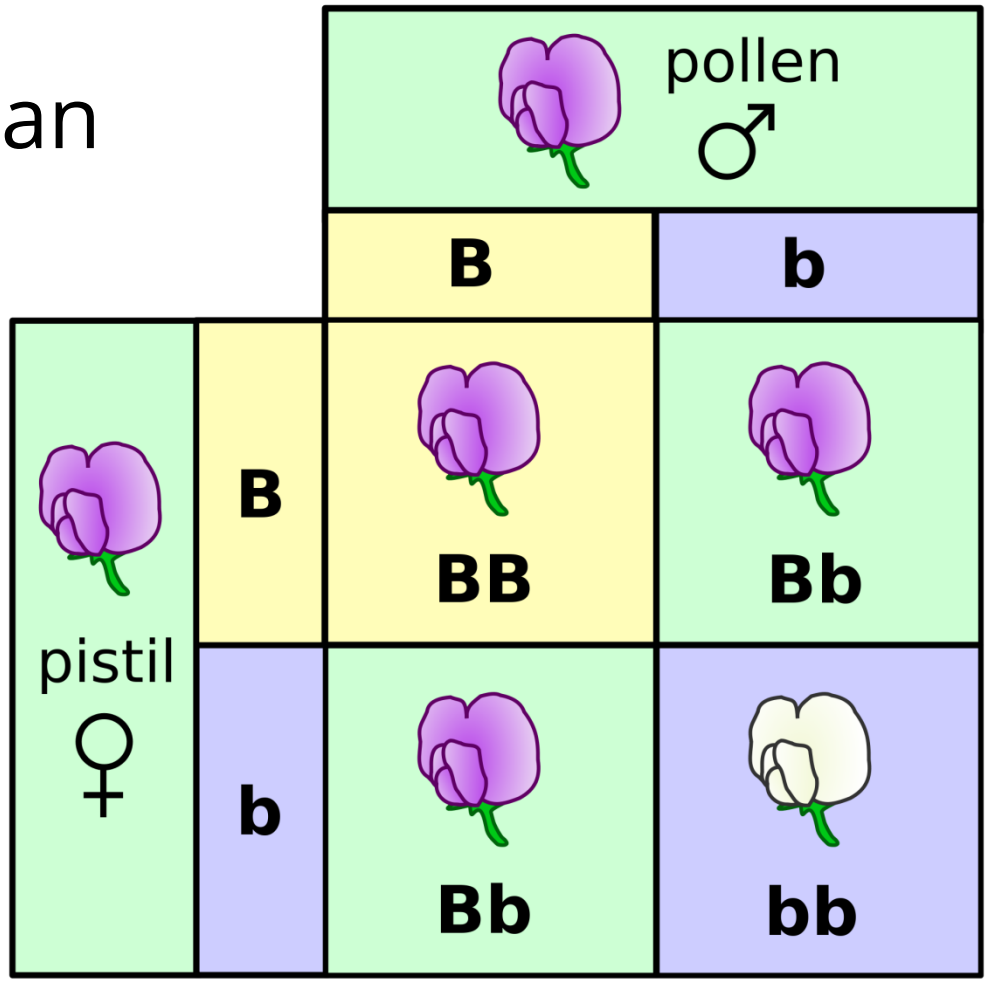
Blue Eyes

Brown eyes are **dominant** to Blue eyes.

The Law of Segregation

During meiosis, each gamete only receives one **allele** for any trait.

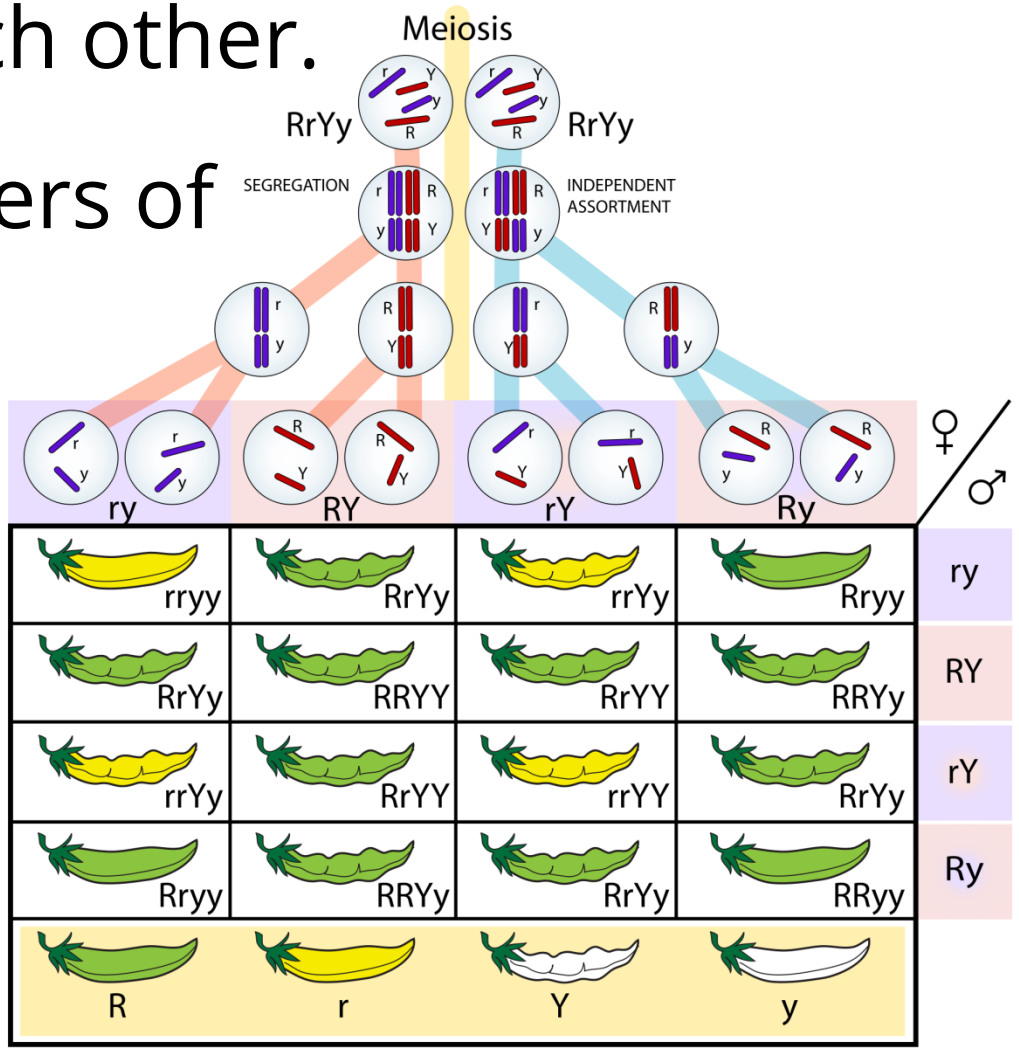
Organisms produce an equal number of gametes with each allele.



Independent Assortment

The segregation of unlinked alleles have no influence on each other.

Proportional numbers of all gametes with all allele combinations will be produced during meiosis.



4.3: The chromosomal basis of inheritance provides an understanding of the pattern of passage (transmission) of genes from parent to offspring.

2. MATH SKILLS: Genetics Probabilities

Independent Events

The inheritance of unlinked genes are independent events.

For any combination of independent events to occur:

$$P\ (A\ \text{or}\ B) = P(A) + P(B)$$

$$P\ (A\ \text{and}\ B) = P(A) \times P(B)$$

Sample Problem:

In pea plants the gene for wrinkled seed pods (R) is dominant to the gene for smooth pods (r), and the gene for yellow seeds (Y) is dominant to the gene for green seeds (y).

A heterozygous wrinkled, yellow pea plant is crossed with a homozygous smooth, green pea plant. What fraction of its offspring will be smooth and yellow?

Sample Problem 2:

In a cross between two organisms with the following genotypes:

AaBBCcddEe x aaBbCcDdEe

What is the probability of getting offspring with the genotype aaBbccDdEE?

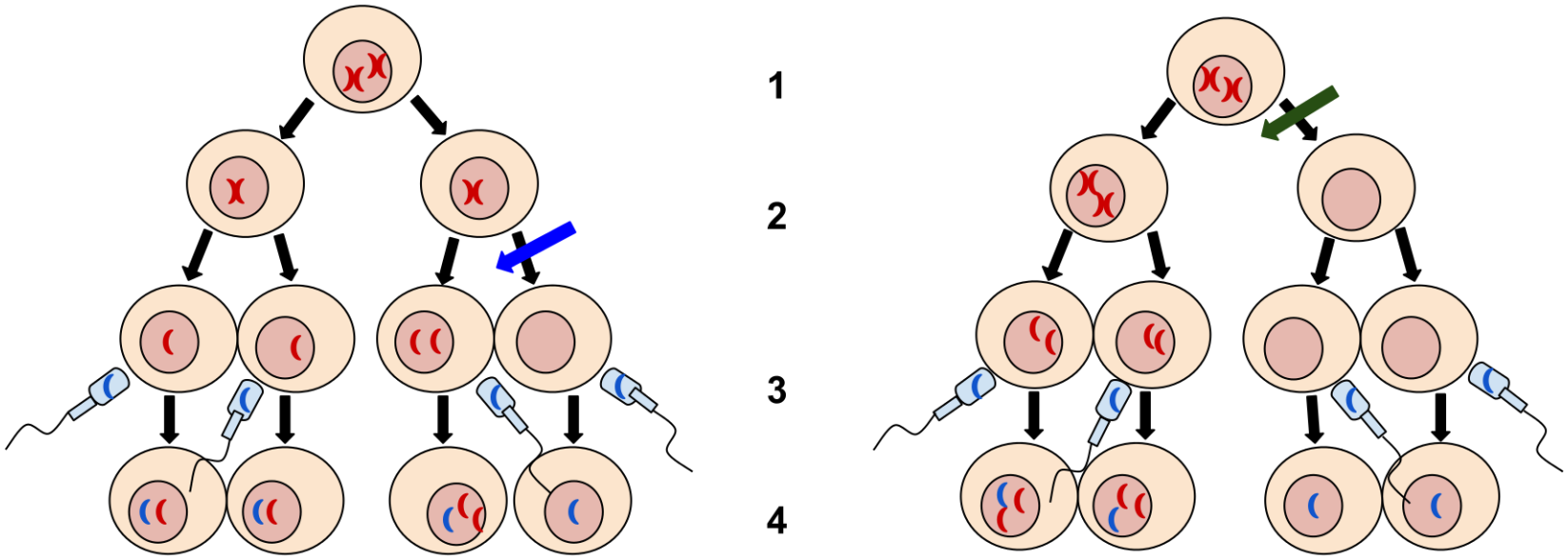
4.3: The chromosomal basis of inheritance provides an understanding of the pattern of passage (transmission) of genes from parent to offspring.

3. Chromosomal Disorders

Non-Disjunction

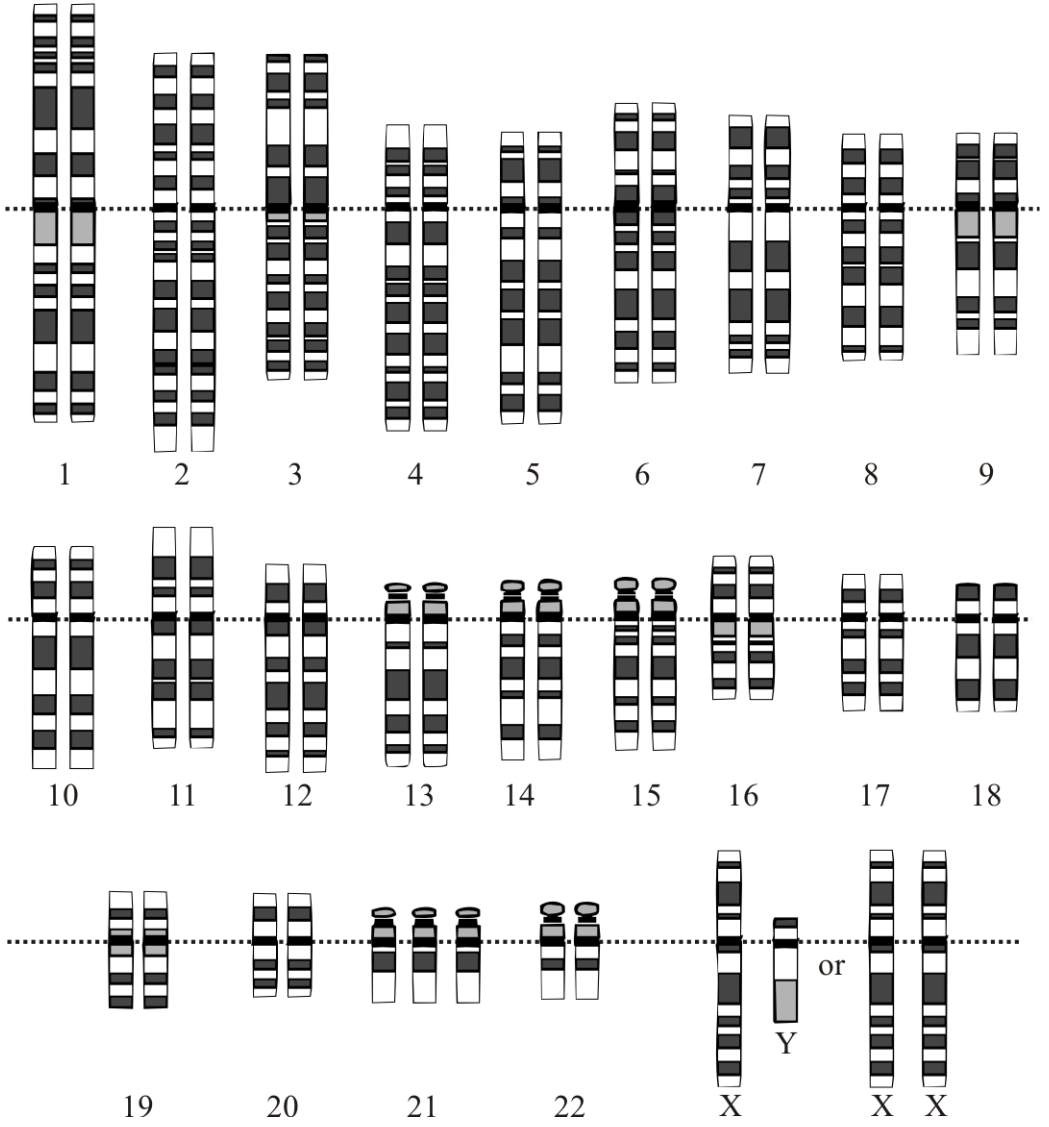
Mistakes during meiosis where chromosomes fail to separate.

Often fatal to the developing organism.



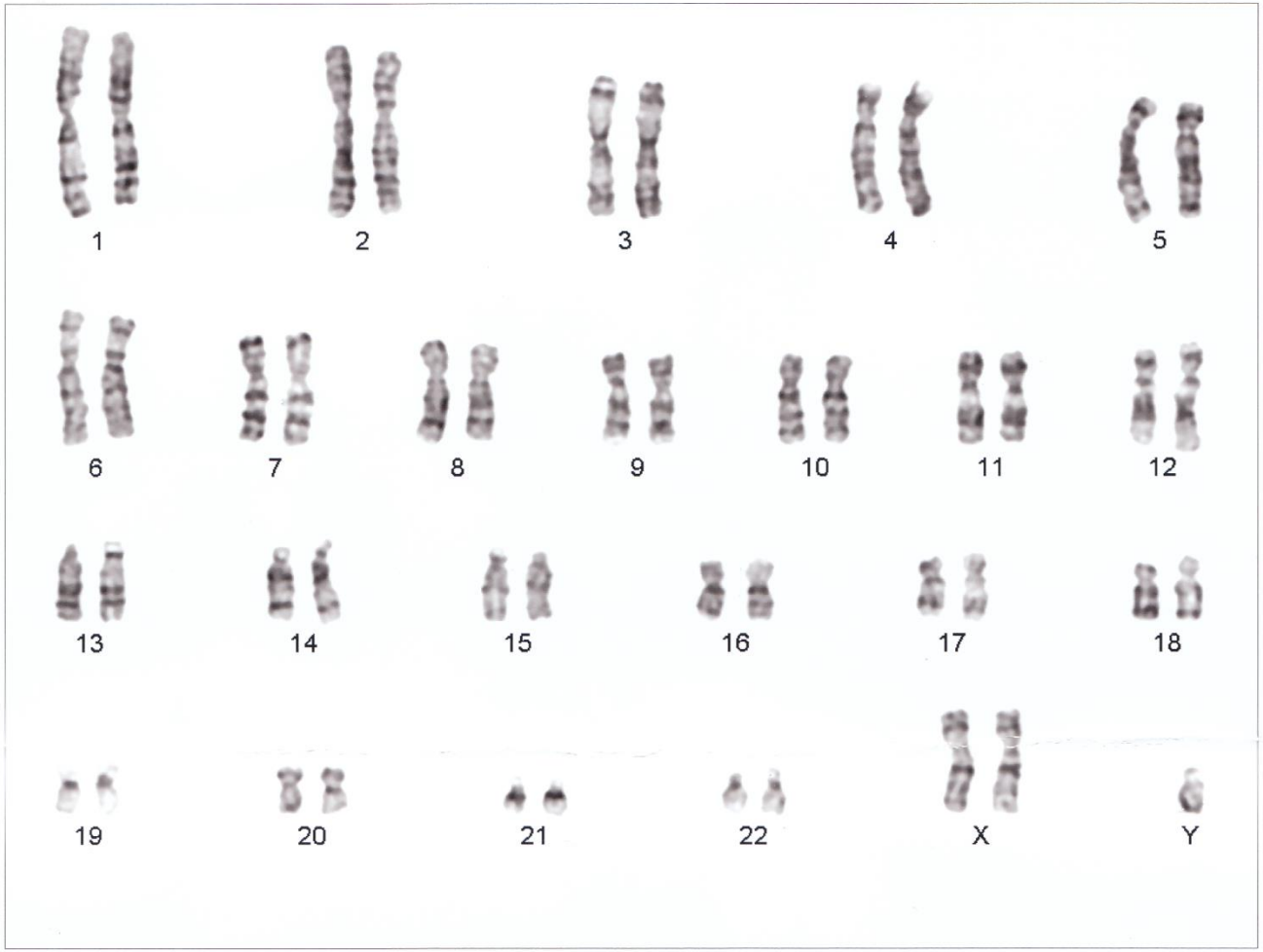
Down’s Syndrome

Trisomy 21



Kleinfelter’s Syndrome

XXY individuals

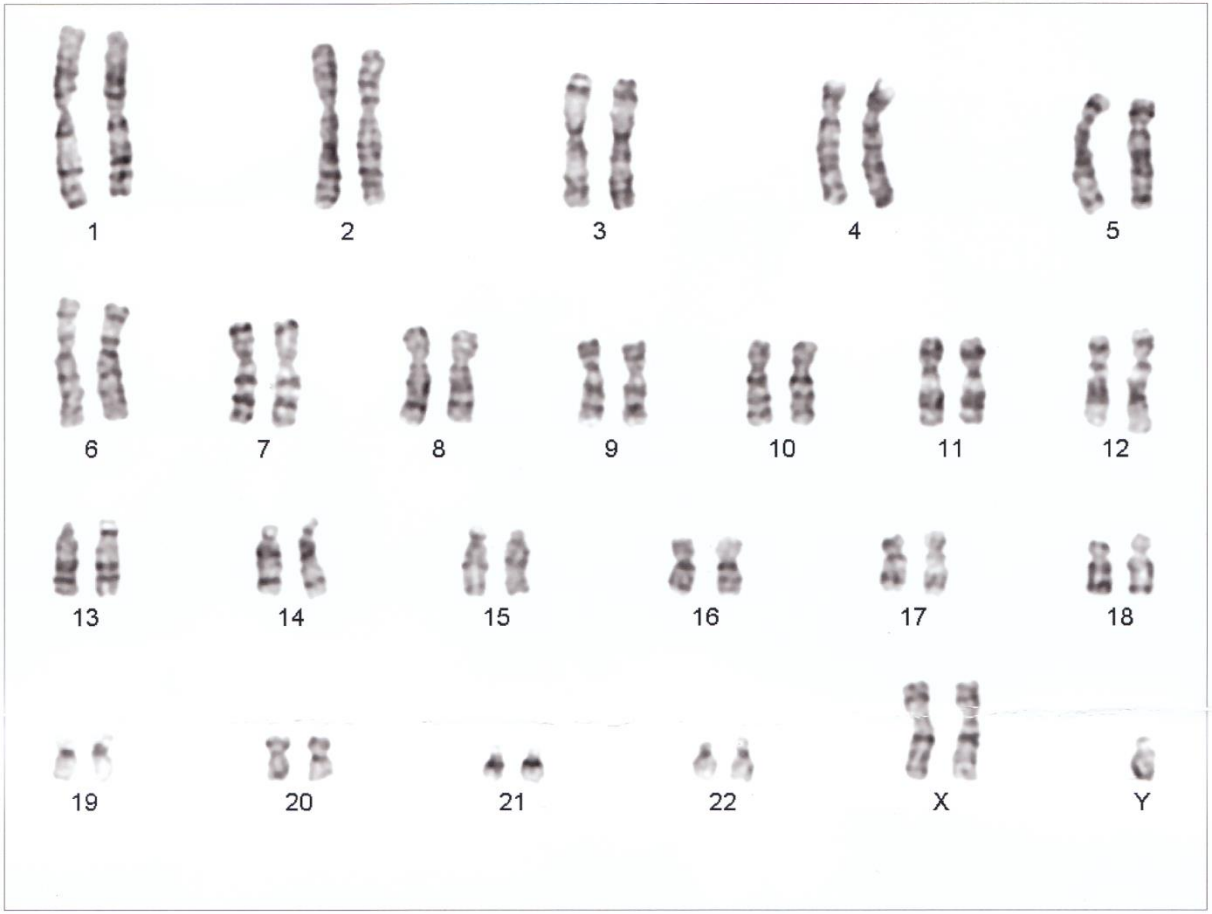


核型：47,XXY

Cell No.：003

Genetic Testing

Genetic Testing is available, but raises ethical questions



4.4: The inheritance pattern of many traits cannot be explained by simple Mendelian genetics.

1. Mendelian Extensions

Mendelian Ratios are Simple

The work done by Gregor Mendel investigated simple, dominant/recessive relationships.

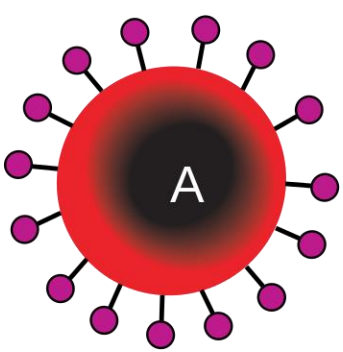
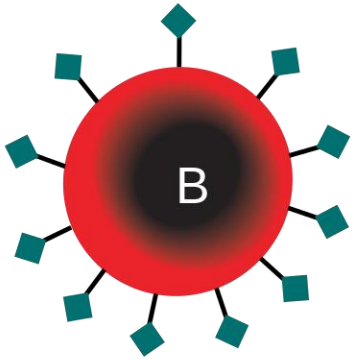
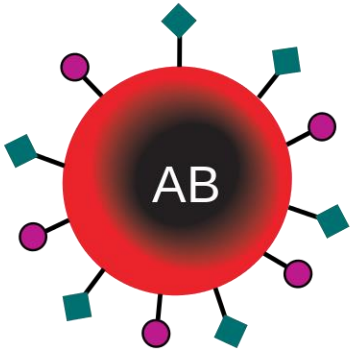
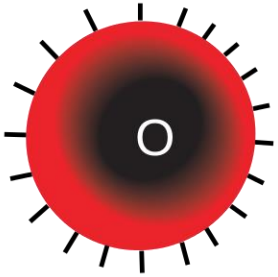
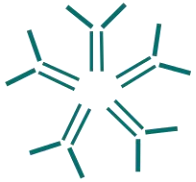
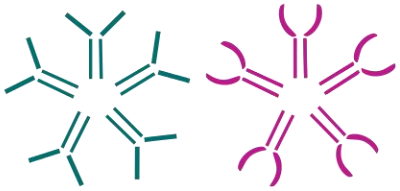
The inheritance of many traits is more complex.

In all cases, the complexity alters the ratios of offspring.

Incomplete Dominance

X

Codominance and Multiple Alleles

	Group A	Group B	Group AB	Group O
Red blood cell type				
Antibodies in Plasma	 Anti-B	 Anti-A	None	 Anti-A and Anti-B
Antigens in Red Blood Cell	 A antigen	 B antigen	 A and B antigens	None

4.4: The inheritance pattern of many traits cannot be explained by simple Mendelian genetics.

2. Non-Mendelian Inheritance

Non-Mendelian Inheritance

Many traits are not inherited according to Mendelian principles.

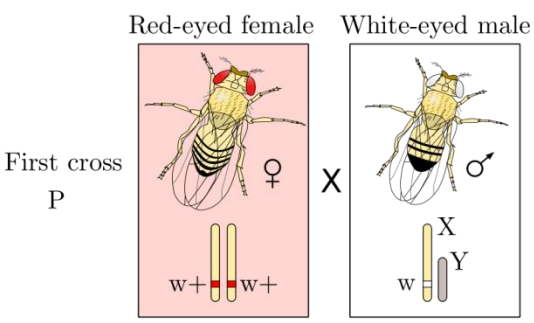
Mendelian ratios only refer to situations where each gene is inherited independently of each other.

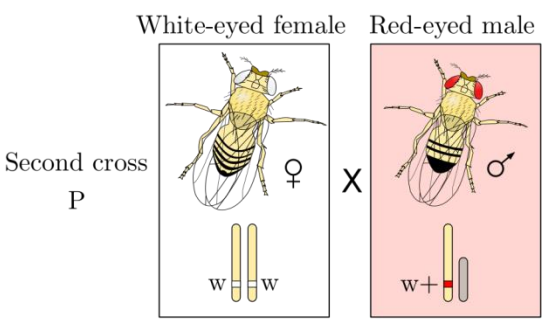
Sex Linkage

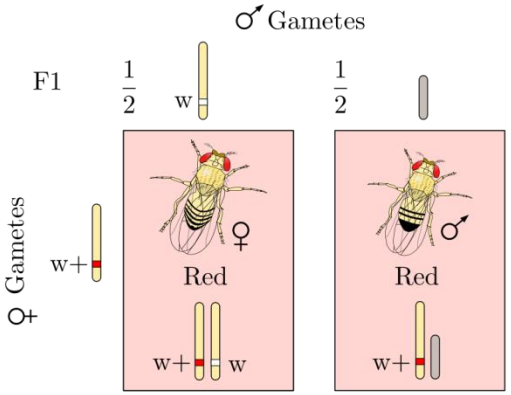
Refers to the inheritance of traits on sex chromosomes.

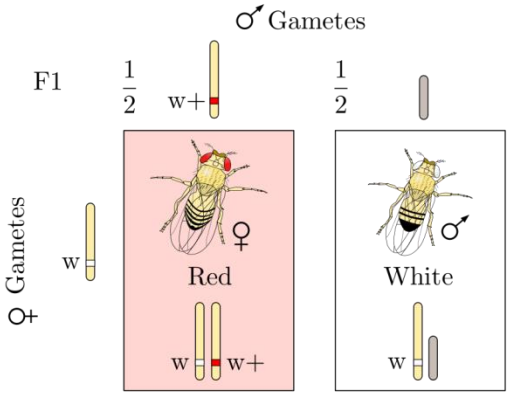
First investigated by the lab of T.H. Morgan in *Drosophila*

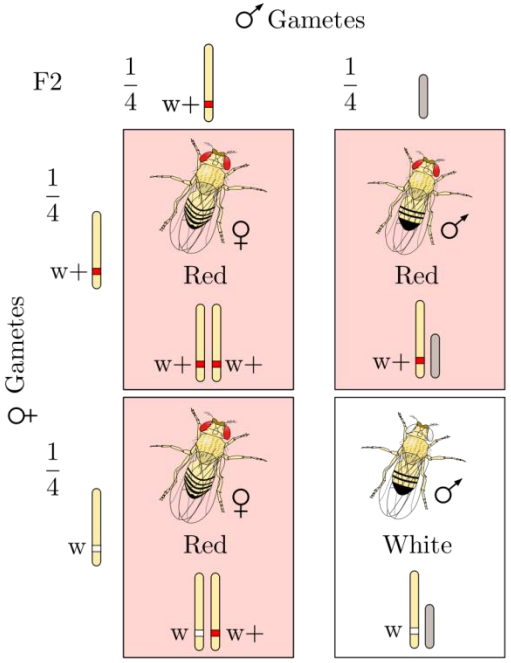
Sex Linked traits show up in males more frequently due to the presence of one X chromosome

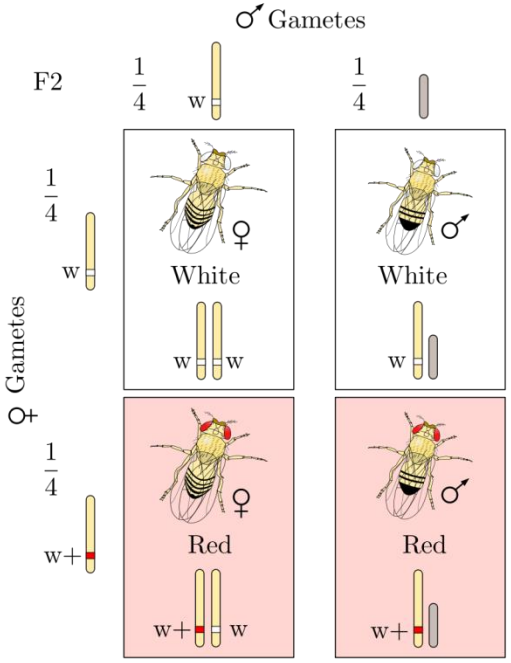


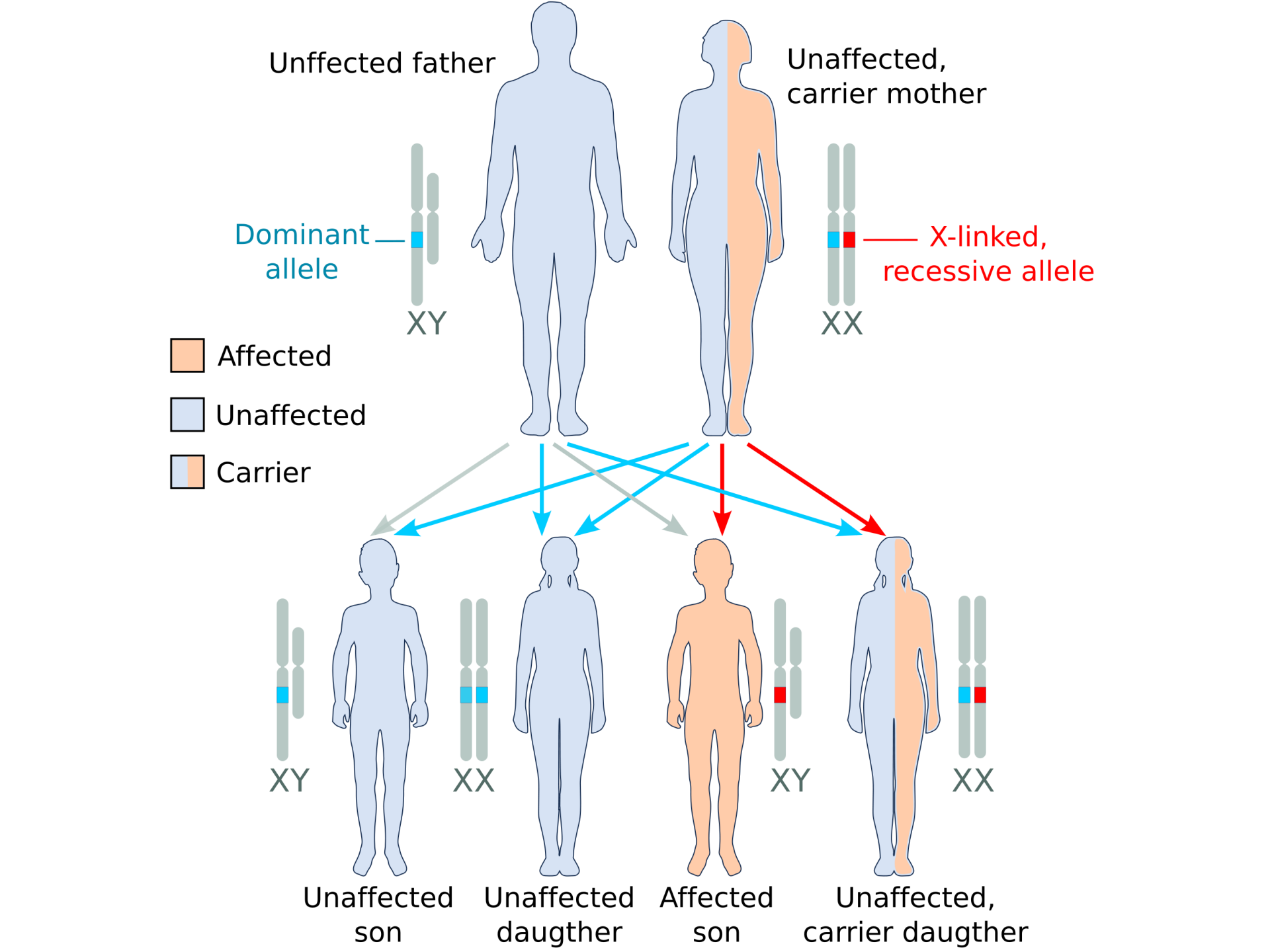











Unffected father
Unaffected,
carrier mother
Dominant
allele
X-linked,
recessive allele
XY
XX
Affected
Unaffected
Carrier
XY
XX
XY
XX
Unaffected
son
Unaffected
daugther
Affected
son
Unaffected,
carrier daugther

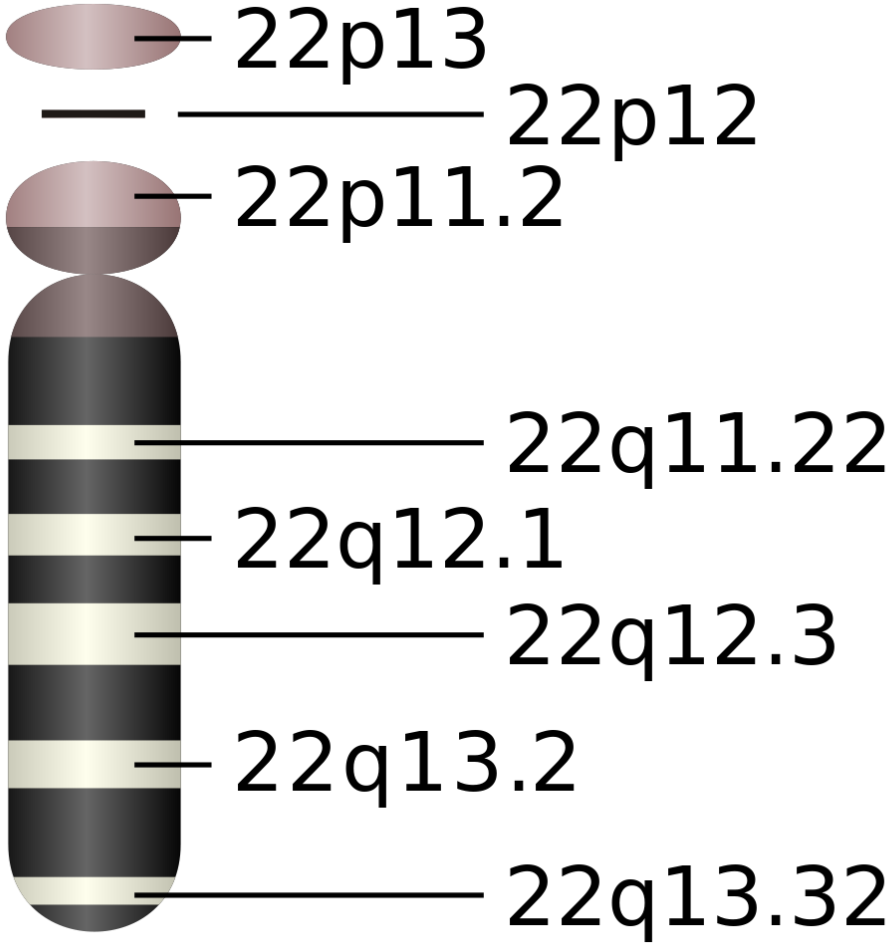
Sex Limited Traits

Traits that are only expressed in one gender.

Linked Genes

Refers to any genes that are on the same chromosome.

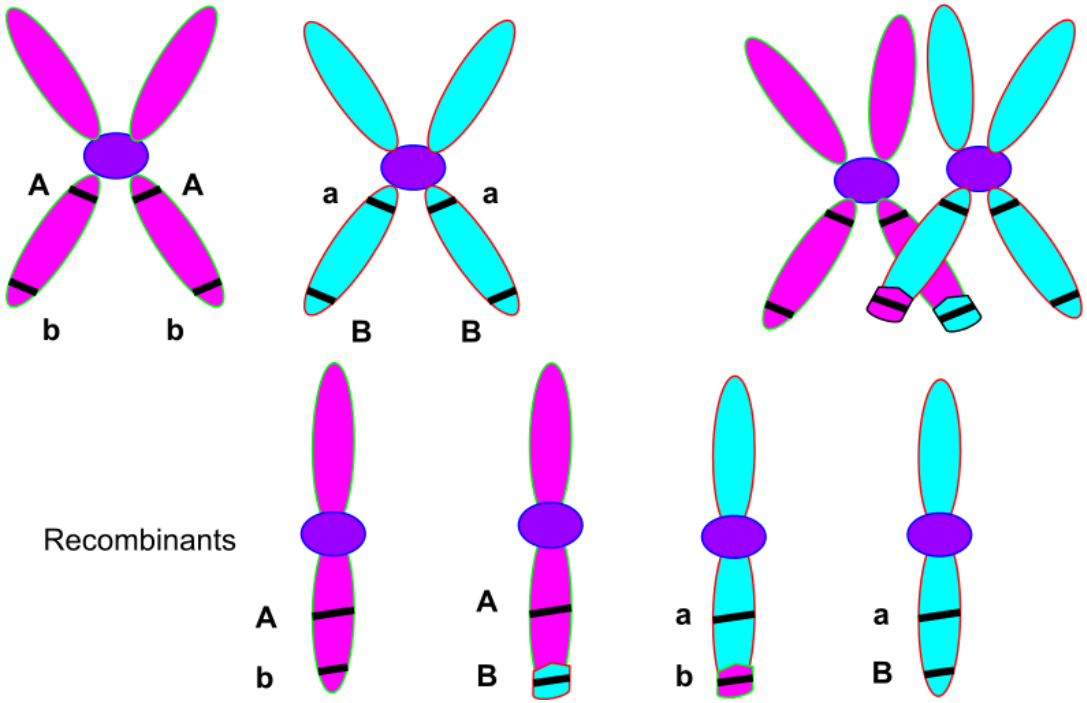
Linked genes will usually be inherited together.



Linkage Analysis

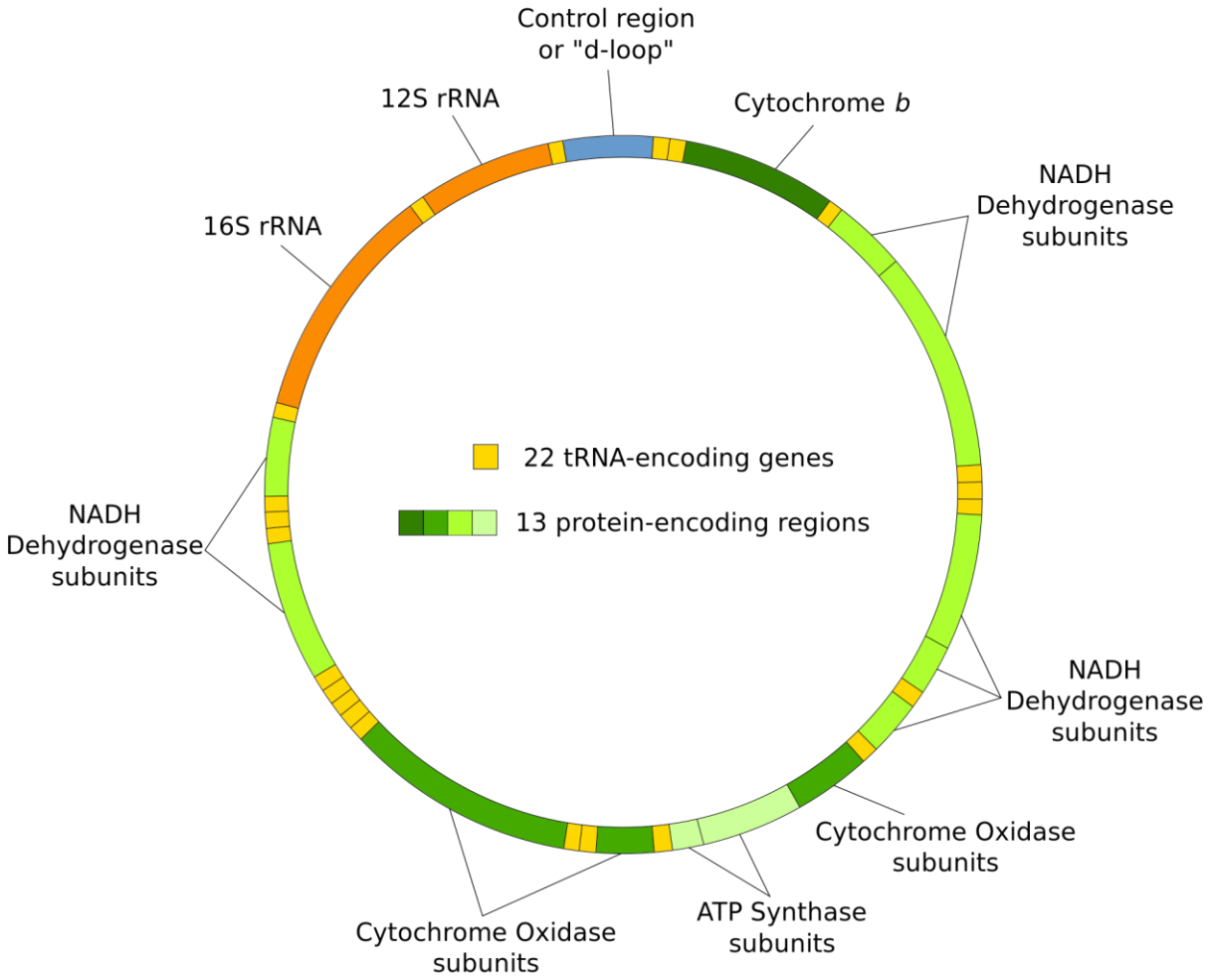
Crossing over can separate linked genes.

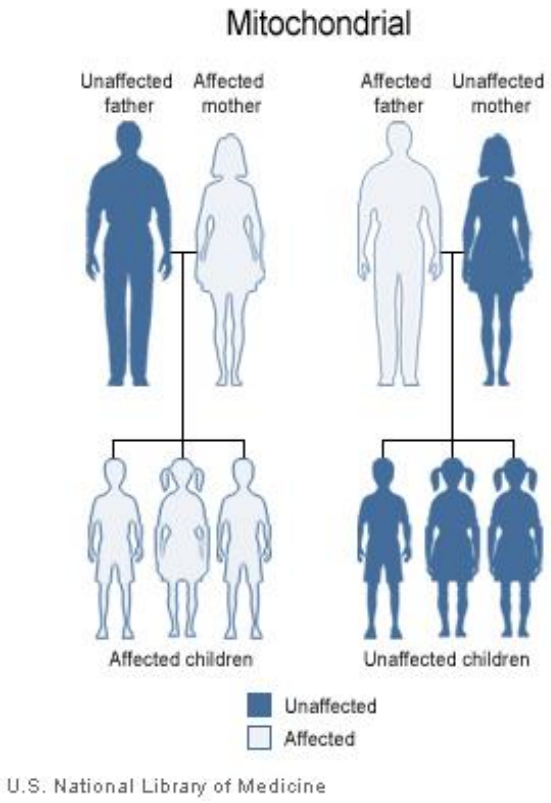
The more distance between two genes on a chromosome, the more frequently crossing over will occur.



Non-Nuclear Inheritance

Chloroplast and Mitochondrial Genomes are inherited entirely from the egg cell.





4.10: Environmental factors influence the expression of the genotype in an organism.

1. Environmental Effects on Phenotype

Phenotype = Genotype + Environment

Phenotypes arise from interactions between the genome and the environment of the organism.

The environment directly controls certain phenotypes.

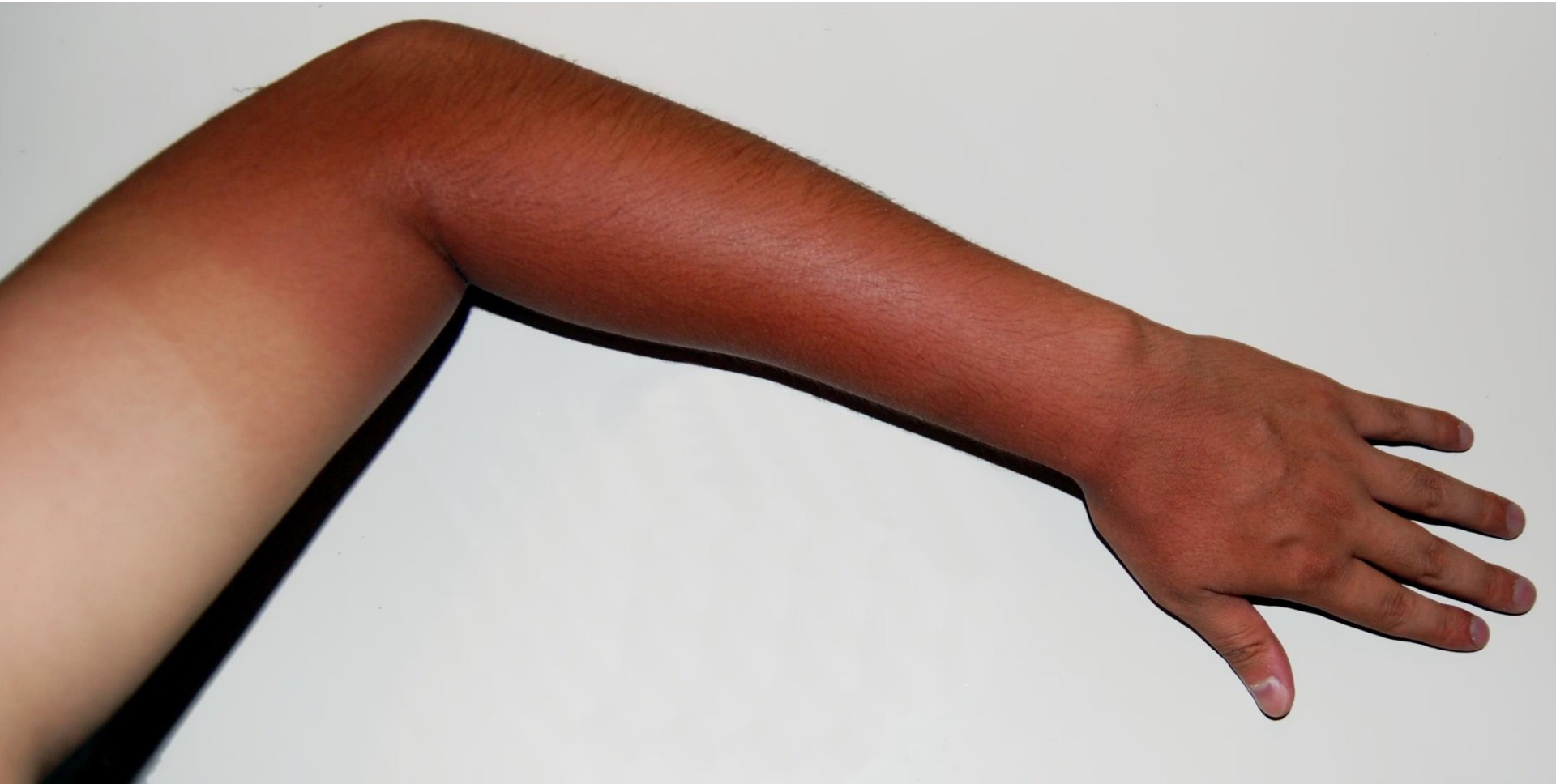
The genome can also respond to environmental changes by altering gene expression.

Ex. Soil pH and Hydrangea Color

Ex. Gender Determination in Reptiles is controlled by temperature.

Ex. Winter and Summer coat coloration in the Arctic Hare

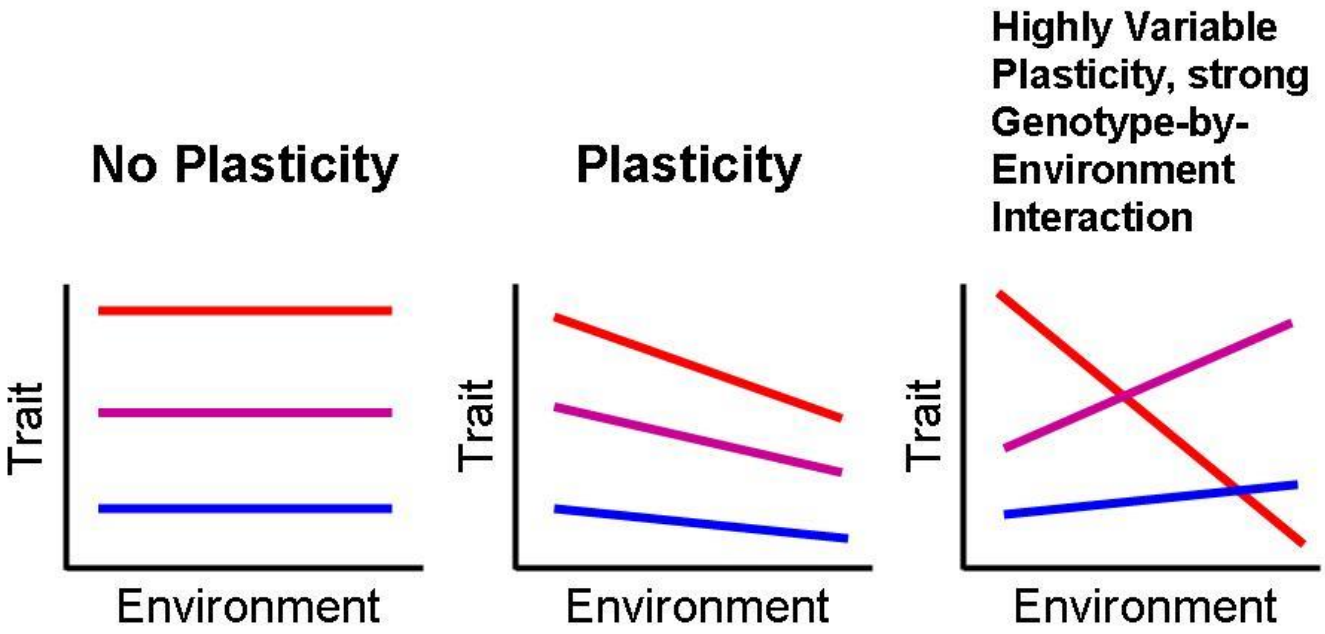
Ex. The Tanning Response in Humans



Plasticity of the Genome

Different traits will interact with the environment in different ways.

The ability of one genotype to produce more than one phenotype when exposed to different environments.



Each of the colored lines is a "Reaction Norm"