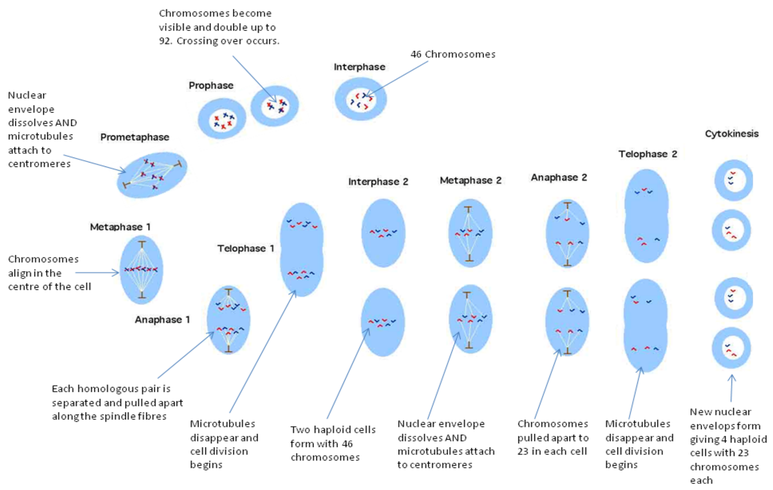
Summary of Meiosis and Laws of Inheritance

MEIOSIS AND VARIATION



CROSSING OVER OCCURS BETWEEN CHROMATIDS IN PROPHASE 1. THE LOCATION WHERE THIS OCCURS IS CALLED THE CHIASMA

Meiosis can be separated into two stages:

- Meiosis I where the homologous chromosomes separate
- And meiosis II where the sister chromatids separate

VARIATION

Variation is important because individuals within a species are different because some will possess more advantageous alleles which may increase the organism chances of survival

The processes of meiosis and fertilisation can lead to variation through the independent assortment of alleles. There are **three** different events/factors which influence variation. These are:

1. **Sexual Reproduction**
2. **Meiosis**
   - **a) independent assortment of chromosomes** in anaphase 1
   - **b)** in anaphase II the same process occurs again but with **sister chromatids separating** into one of four new cells!
   - **c) crossing over** during prophase I
   - **d) Mutations**
3. **Environmental factors**

   E.g. Plants! They grow better when there is more sunshine or there are more nutrients in the soil such as nitrates, phosphate and potassium.

   Or Arctic Fox that changes the colour of its fur depending on the season.

In Bacteria…

Environmental Changes can Switch on Bacterial Genes!

MENDELS LAWS OF INHERITANCE

2 LAWS

- **Law of Segregation**—when gametes are produced and only end up with 23 chromosomes each instead of 46 chromosomes. i.e. one copy of gene instead of two!
- **Law of Independent Assortment**—when genes assort independently from one another. This occurs during metaphase 1 of meiosis where chromosomal cross over can occur

A Mendelian trait is one that is controlled by a single locus and shows a simple Mendelian inheritance pattern e.g.**figure 2**

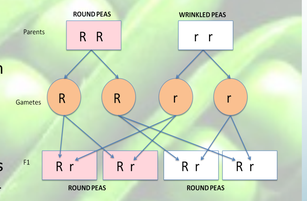


Figure 2: A genetic diagram of a monohybrid cross (a cross only involving one gene) between round and wrinkled peas

SEX-LINKED INHERITANCE!

The female is the homozygous sex possessing two X chromosomes (XX)
The male is heterozygous possessing only one X chromosome (XY)
Genes on the X or Y chromosome are called sex linked genes. Males are also called **hemizygous** because they only possess one copy of the gene
Examples such as haemophilia and colourblindness are due to the genes being found on only the X chromosome and NOT the Y chromosome. Therefore they are sex-linked genes!

	X^R	X^R
X^r	X^RX^r	X^RX^r
Y	X^RY	X^RY

INCOMPLETE DOMINANCE!

Codominance occurs when two alleles are BOTH dominant and create a **third phenotype**. This occurs when both alleles express their phenotype (usually visible). There are two outcomes of codominance.

Incomplete dominance and codominance!

Incomplete dominance is when the two dominant alleles BLEND together and create a new phenotype. For example in flowers both red and white petal alleles are dominant. However, if a flower possesses both one red allele and one white allele the petal phenotype will be pink!

	W	W
R	RW	RW
R	RW	RW

BUT! CODOMINANCE…

Codominance is when the dominant alleles APPEAR TOGETHER i.e. express their individual phenotype.
The ABO blood group system is codominant because they create a new phenotype —> AB
I^A and I^B are dominant phenotypes and I^O is recessive.

	I^B	I^O
I^A	I^AI^B	I^AI^O
I^O	I^BI^O	I^OI^O

DIHYBRID INHERITANCE—TWO GENES INHERITED TOGETHER!

Example: *Drosophila* can either have a grey or ebony body with either normal or vestigial wings.

Crossing **heterozygous F1 generation** fly (NnGg) with a **double homozygous recessive** fly will give a 1:1:1:1 ratio as shown in figure 3. Cross these gametes to create the F2 generation and you get a 9:3:3:1 ratio! This is shown in figure 4.

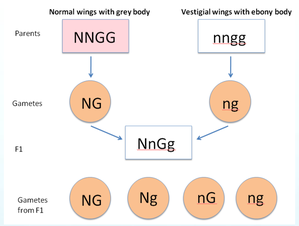


Figure 3: a genetic diagram of a dihybrid cross in *Drosophila* between a normal winged and grey bodied fly with a vestigial winged and ebony bodied fly.

	NG	Ng	nG	ng
NG	NNGG	NNGg	NnGG	NnGg
Ng	NNGg	NNgg	NnGg	Nngg
nG	NnGG	NnGg	nnGG	nnGg
ng	NnGg	Nngg	nnGG	nngg

Figure 4. This is a punnett square diagram displaying the possible genotypes of the F2 generation when crossing the gametes from F1 generation. Within the punnett square the different colours represent the three different possible phenotypes that can occur from their genotype.

NNGG/NNGg/NnGG/NnGg—*Normal wings grey body;*

NNgg/Nngg—*Normal wings ebony body;*

nnGG/nnGg—*Vesigial wings grey body*

nngg—*Vestigial wings ebony body*

NB– Chi Squared Test

The formula is:

$$X^2 = \sum \frac{(O-E)^2}{E}$$

O = observed number of individuals
E = expected number of individuals
Σ= sum of deviations for all phenotypes

Don't forget to check your answer against the **Chi squared table** using your calculated degrees of freedom to see if your results are statistically significantly different!