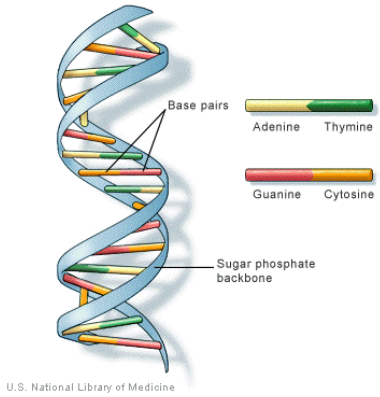
What you need to know for...

AS 90948 - GENETICS

- external, 4 credits

GENETIC INFORMATION



DNA is the molecule that conatins all of the genetic information for an organism. The DNA is coiled up into **chromosomes**, each containing many genes.

Each **gene** codes for a single **trait** (characteristic). Many genes have **alleles** (gene forms), *e.g. the gene for eye colour has many alleles.*

The code is carried on DNA by the **bases** (**A**, **T**, **C**, or **G**).
A **change in a base triplet** results in...
a **change in an amino acid**, therefore...
a **change in protein**, therefore...
a **change in the phenotype** - a new allele.

In this way, a **mutation** (change in the DNA code) affects the **phenotype** (appearance) by making a new allele.

SEXUAL REPRODUCTION

Chromosomes exist in **homologous pairs**; 1 set from mum and 1 set from dad. Therefore we have **two copies of each gene**.

Many species use **sexual reproduction** (2 parents). The parents produce **gametes** (**sex cells**) with **one set of chromosomes** in a process called **meiosis**.
So, gametes allow information from 2 different individuals to be combined in one **zygote** (fertilised egg).

Meiosis increases variation by:
⇒ **Segregation** - producing gametes allows information to be combined between 2 individuals
⇒ **Independent assortment** - the way the chromosome pairs are put into gametes is **random** (~ 8 million different combinations per person)
⇒ **Crossing over** - parts of chromosome pairs can swap during meiosis

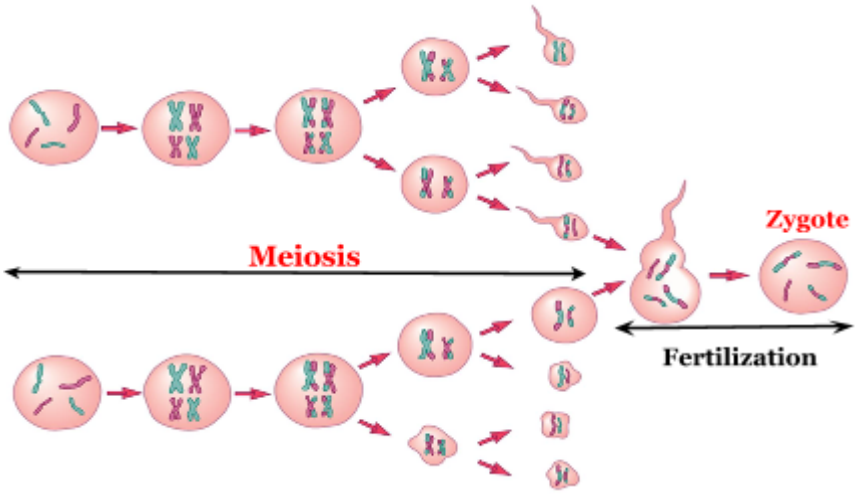
Sex determination:

Males can produce gametes with an X or a Y.
Females always produce gametes with an X.

Male XY

Female XX	X	Y
X	XX	XY
X	XX	XY

Offspring:
50% Male
50% Female



VARIATION

Variation (differences within a species) is very important.

Some variation is **inheritable** (can be passed on), i.e. anything in the DNA of gamete making cells. Some is **non-inheritable** (cannot be passed on), i.e. changes to the body only (e.g. damage from an accident).

When conditions change (a new disease/new predator/flood/drought, etc) the **best adapted individuals will be more likely to survive**, therefore reproduce, therefore that phenotype will be **selected for** (increase in the population). This reflects an increase in that *genotype* as well.

More variation in a species means more survival chances.

Sexual reproduction advantages:	**Sexual reproduction disadvantages:**
Increased **variation**	requires **specialized features** (genitals, flowers etc.) needs special cell division (**meiosis**) more **energy** more **time**

INHERITANCE

Some alleles are **dominant** (cannot be hidden) and the others are **recessive** (can be hidden).

The description of the alleles present are **genotype**.

Having one of each allele is to be **heterozygous** for a trait (Rr).

An individual could also be **homozygous *recessive*** (rr), or **homozygous *dominant*** (RR).

Homozygous individuals are **pure breeding** as they have no hidden alleles.

Example: *The allele for tongue rolling (R) is dominant over the non-rolling allele (r).*
2 heterozygous people have children:

Punnett square:
This is not guaranteed to happen as it depends on chance as each offspring is an **independent event**.

	R	r
R	RR	Rr
r	Rr	rr

This outcome can be expressed as:

Genotype ratio = 1 RR : 2 Rr, 1 rr

Phenotype ratio = 3 rollers : 1 non-roller

A **test cross** (cross with rr - **homozygous recessive**) can be used to determine an unknown genotype.
If ***any*** offspring show the **recessive** trait (rr), the unknown ***must* be heterozygous** (Rr).

If ***all*** offspring show the **dominant** trait (R_), the unknown is ***probably* homozygous** (RR).
Need a good number to be certain.

A **pedigree chart** is a family tree for a trait.

In this case, the shaded trait must be recessive, as it can be hidden (e.g. in generation I), and then pop up in the next generation.
Parents must be Bb and Bb (unaffected), giving a 25% chance of having affected offspring.