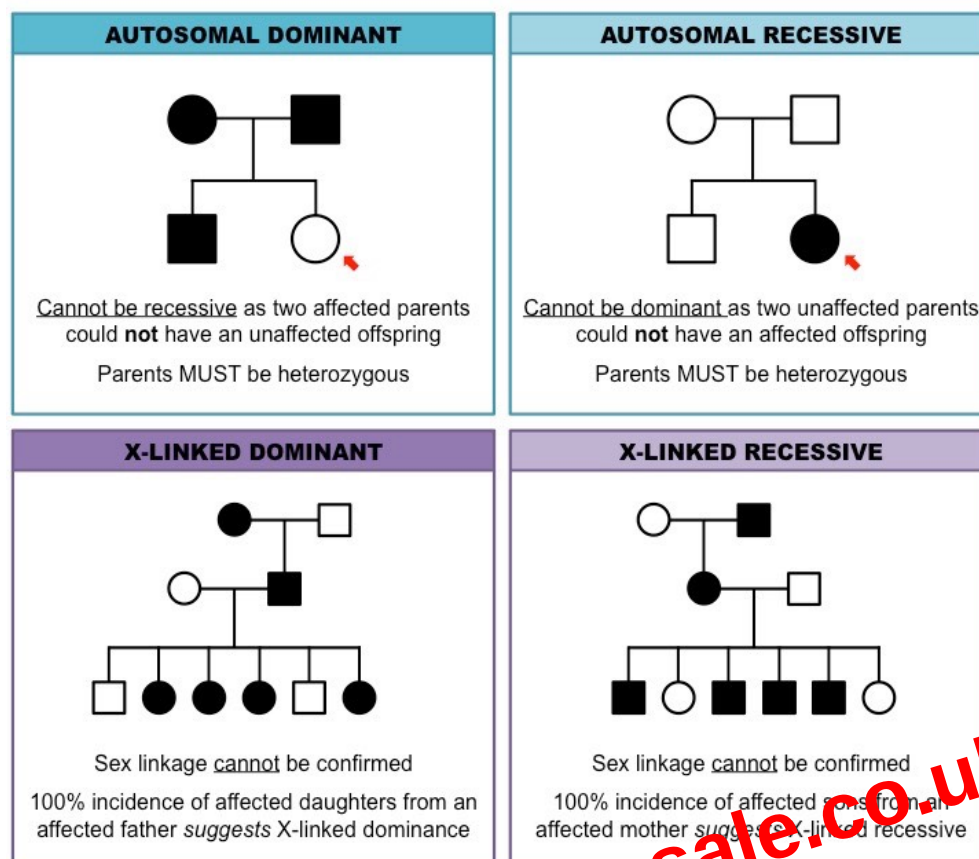


Pedigree Charts:



Mutations:

Mutations are **spontaneous**, permanent changes in the base sequence of DNA – they can occur at any time in any organism. Usually the natural rate of mutations is very low but some **environmental factors** can significantly increase the number and frequency of mutations. Ionising radiation from nuclear plants, ultraviolet light (UV), X-rays and mutagenic chemicals such as formaldehyde, benzene and tobacco tar are **mutagens**, which increase mutation rate.

Autosomal Dominance:

All affected individuals must have at least **one affected parent**. If two parents are unaffected, all offspring must be unaffected (**homozygous recessive**). If you two are affected, they may have offspring who are unaffected (if parents are **heterozygous**).

Autosomal Recessive:

If two parents show a trait, all children must also show the trait (**homozygous recessive**). An affected individual may have two normal parents (if parents are both **heterozygous** carriers).

Genetic Disorders:

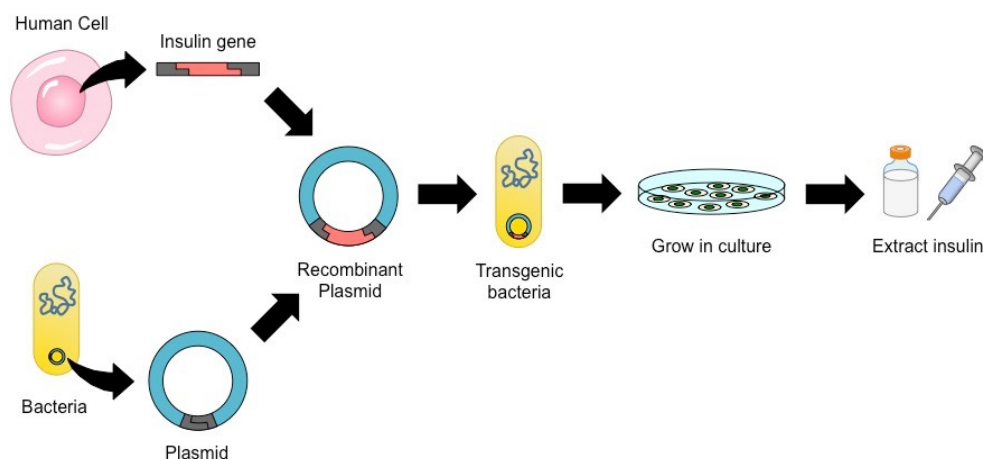
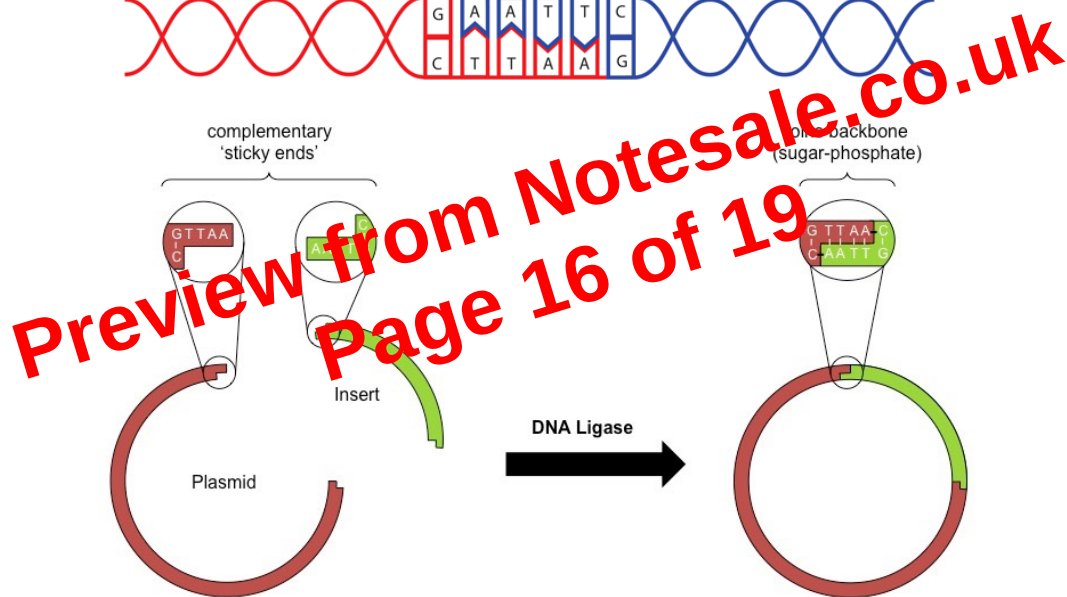
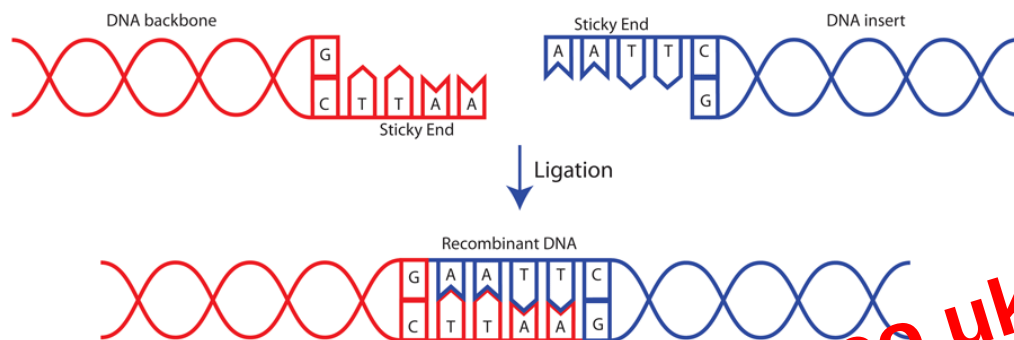
Disorder	Chromosome	Dominant or recessive
Huntington's	4	Dominant
Haemophilia	X	Recessive
Colour blindness	X	Recessive
Cystic fibrosis	7	Recessive

Insulin Production:

One of the first important uses of gene transfer was to **produce insulin** for diabetic patients whose own bodies do not produce insulin properly. Many years ago, insulin was obtained from a cow or a pig pancreas but the process was difficult and the insulin was likely to be contaminated. Today, diabetics inject themselves with human insulin that has been made by modified *E. coli* bacteria.

There are three key steps in the process:

1. **Obtaining** the desired **human insulin gene** in the form of piece of DNA.
2. **Attaching this DNA to vector**, which will carry it into the host cell (*E. coli*) – the vector used is the plasmid found inside the bacterium.
3. **Culturing *E. coli* bacteria** so that they translate the DNA and make insulin, which is collected.



Bt Corn:

Bt corn is a genetically modified maize that incorporates an **insecticide producing gene** from the bacterium *Bacillus thuringiensis*. This toxic protein is lethal to certain types of larvae, particularly the European corn borer which would otherwise eat the crop. Concerns have been raised that the spread of Bt corn may also be impacting the **survival rates of monarch butterflies**. While monarch butterfly larva feed exclusively on milkweed, wind-borne pollen from Bt corn may dust nearby milkweeds.

Researchers at Iowa State University said they had found monarch butterfly caterpillars were seven times more likely to die when they ate milkweed plants dusted with pollen from Bt-corn rather than unmodified maize in the laboratory.

Some scientists suggested that these **results may lack validity** as they do not accurately reflect natural conditions:

- There were higher amounts of Bt pollen on the leaves than would be found naturally.
- Larva were restricted in their diet.

A **second study** was conducted comparing the survivor rates of monarch butterflies based on proximity to Bt corn fields:

- There was no significant increase in mortality when monarch larvae were placed in or near an actual Bt corn field.
- From this it was concluded that exposure to Bt pollen poses no significant risk to monarch butterfly populations.

Advantages of Genetic Modification:

- As our population increases and more people need feeding, modifying plants and animals to increase yield or to be able to grow in places where they previously could not, will **provide more food**. Plants can be made tolerant to drought or salt water so that food can be grown in difficult areas.
- Crop plants that are **disease resistant** not only increase yields but also reduce the need for applying potentially harmful pesticides.
- Many substances, such as human growth hormone, a blood-clotting factor, antibodies, and vitamins, are already being made by genetically modified organisms to **improve human health**.
- Plants can be **nutritionally enhanced**.

Disadvantages of Genetic Modification:

- They argue that animals could be **harmed** by having these **genes inserted**.
- There is concern that people **consuming** genetically modified plants and animals could be **harmed**.
- The **long-term effects** of genetically modified crops in the environment are not known. Plants or animals could 'escape' into the environment and their genes might become incorporated into wild populations, with unknown effects.
- Human food crops could become **controlled** by a small number of **biotechnology companies**.
- GM seeds/plants may be **more expensive**, preventing poorer farmers from buying them. Wealth might become concentrated in a smaller percentage of the population, which might damage the local economy.
- More genetically modified organisms might lead to a **reduction in natural biodiversity**.