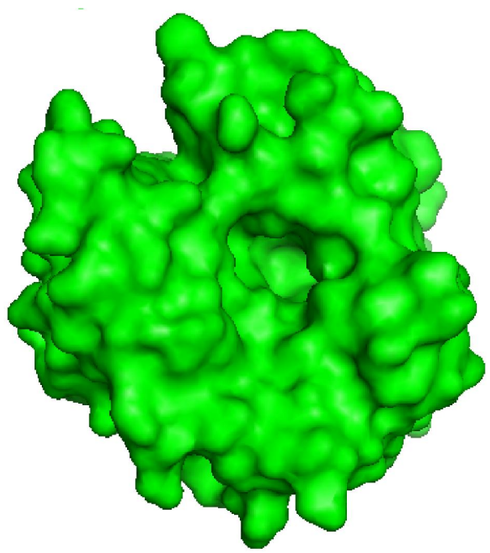
RC2 - Enzymes, Enantiomers, and DNA – Chemistry Revision

What is the monomer subunit of an enzyme?
Amino acids.

Enzymes are examples of biological catalysts. In general, how do enzymes do this?
They accept a **substrate** into a very **specific active site**. This active site then **interacts** with the substrate, using a catalytic triad which consists of different amino acids. Each amino acid has a specific role, one may act as a base, one as an acid, another a nucleophile etc. Together they can **catalyse a specific reaction**.

Why are enzymes stereospecific? And how are they able to differentiate between two enantiomers?
Because the **active site** of an enzyme is made from **amino acids**, which are **chiral molecules**. This means that they will **interact differently with other chiral molecules**, such as **enantiomers**.

How does an inhibitor stop an enzyme working as effectively?
Inhibitors **block the active site** of an enzyme, **stopping it from accepting the usual substrate**.



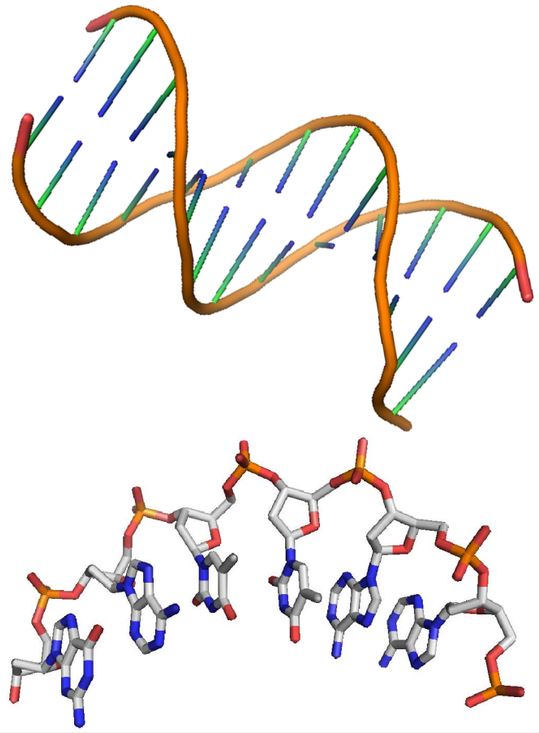
Substrates can exist as enantiomers. Define the term enantiomer:
Molecules which are **non-superimposable mirror images** of each other. They are also known as **optical isomers**, because they are isomers which can be differentiated based on their interactions with light.

Draw the enantiomer of the drug shown below:

How do the chemical properties of two enantiomers differ?
They are **identical**, **except from their interactions with other chiral compounds**. Chiral reagents can differentiate other chiral compounds.

How do the physical properties of two enantiomers differ?
They are **identical**, **except for their interactions with plane-polarised light**. Each enantiomer will rotate the plane of plane-polarised light in a different direction.

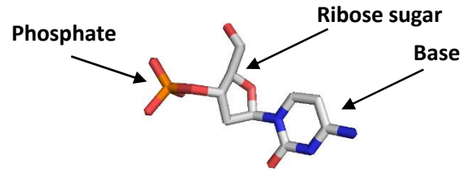
How can two enantiomers be differentiated?
By using a **polarimeter** to measure the effect each has on plane-polarised light.



DNA exists as a double helix structure. Explain why the two DNA strands involved are said to be complementary:
Because the **DNA bases on one strand match up to the DNA bases on another**. **Adenine will only bond to thymine**, and **cytosine will only bond to guanine**. For a DNA strand to bond to another, the **sequence of DNA bases must be exactly complementary**.

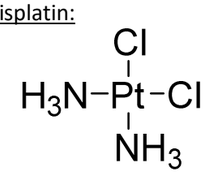
Which type of bonding joins the two DNA strands together? How does this type of bonding arise in DNA?
Hydrogen bonding between the **base pairs** on each strand. Adenine bonds to thymine, and cytosine bonds to guanine.

Label the three components of a DNA nucleotide:



Describe how a single strand of DNA can form from nucleotide units. State the type of bonding involved and explain how these bonds form:
Covalent bonds form between the **sugar** of one nucleotide and the **phosphate** of another. This occurs through **condensation** reactions, which **eliminate** a molecule of water each time. This process is repeated to form a **sugar-phosphate backbone**. These covalent bonds are known as phosphodiester bonds.

Draw the structure of the complex cisplatin:



Give a use of the complex cisplatin:
Treats cancers

Explain how cisplatin achieves this:
Cisplatin binds to the DNA strands, and **prevents** the **strands from unwinding**. This **stops DNA from replicating**, and therefore **cancer cells cannot replicate**. This stops tumours from growing.

Why can drugs such as cisplatin have adverse side effects? And how can these be limited?
They can **attack healthy cells** as well as malignant ones. This can be limited by **targeting the treatment** to only the affected area, and by using the **smallest necessary dose**.

Produced by Adam Stubbs at Newcastle University as part of a summer outreach project.