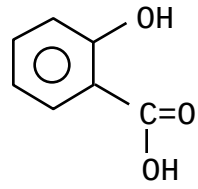
MEDICINES

Drugs are substances which alter the biochemical processes in the body. We say they are 'pharmacologically active'.

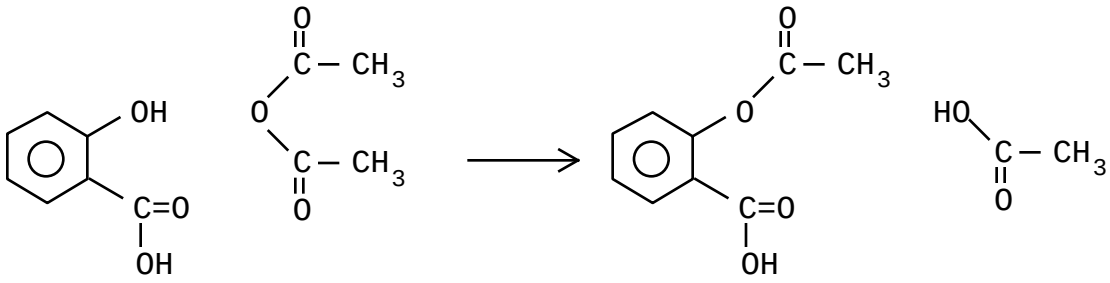
Beneficial drugs are called medicines.

The first primitive medicines were extracted from plants. Salicylic acid is an analgesic (pain reliever) obtained from willow bark.



Salicylic acid

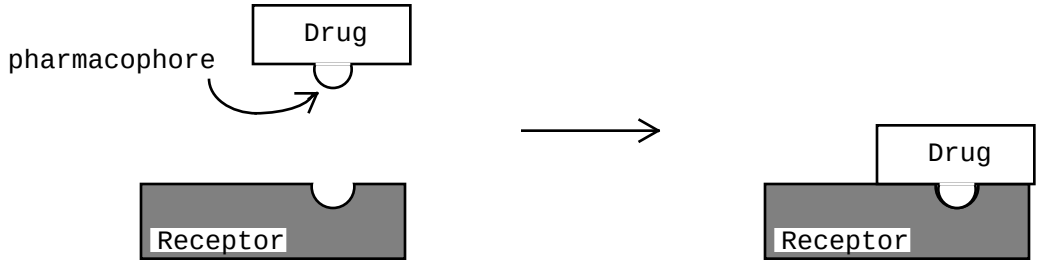
Some of the first synthetic drugs were derivatives of these natural compounds e.g. the reaction of Salicylic acid with Ethanoic anhydride produces Aspirin - an analgesic, antipyretic (lowers temperature) and anti-inflammatory:



Salicylic acid | Ethanoic anhydride | Aspirin | Ethanoic acid

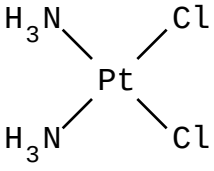
45000 tons of Aspirin are consumed in the world every year!

Most drugs work by binding to receptor molecules - proteins on the cell surface or enzymes. Pharmacophores, functional groups on the drug molecule, have the correct shape to fit into active sites on the receptor molecule and bond with functional groups on the receptor molecule.

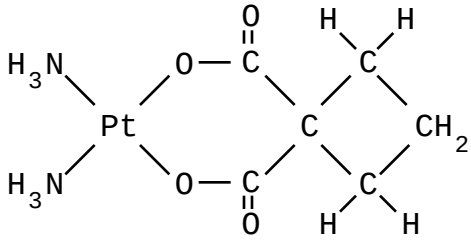


By comparing the structures of drugs with similar pharmacological activity, the pharmacophore can be identified.

e.g. Both Cisplatin and Carboplatin can be used in the treatment of tumours:

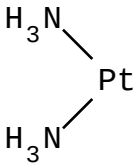


Cisplatin



Carboplatin

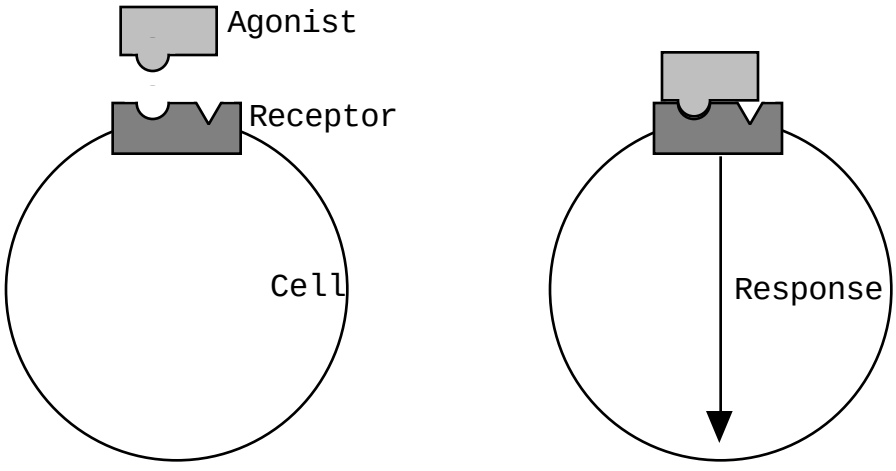
The group:



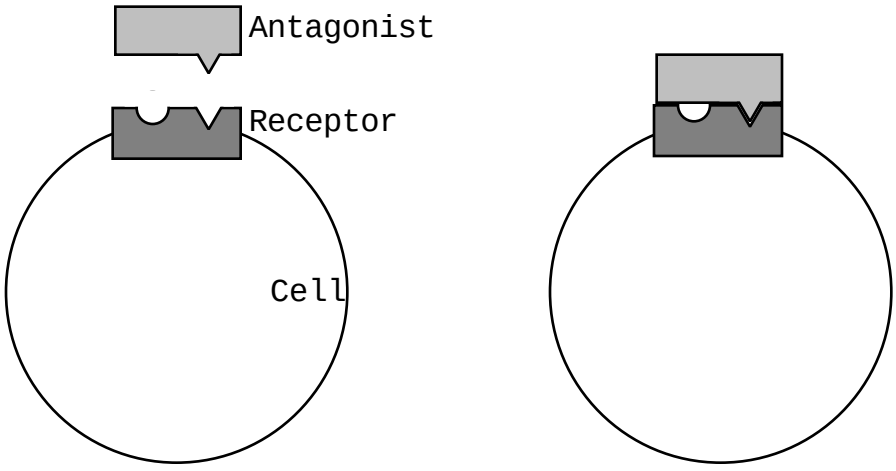
is the most likely pharmacophore as it is common to both molecules.

There are two types of drug molecules: **Agonists** and **Antagonists**

Agonists are drugs which produce a response when they bond to the receptor.

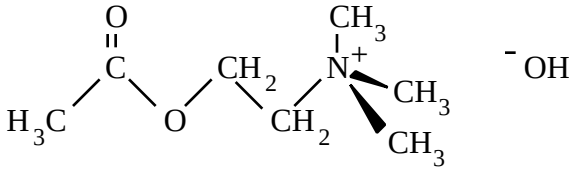


Antagonists are drugs which bond to the receptor but do not produce a response. They therefore block the receptor preventing the binding of an agonist.

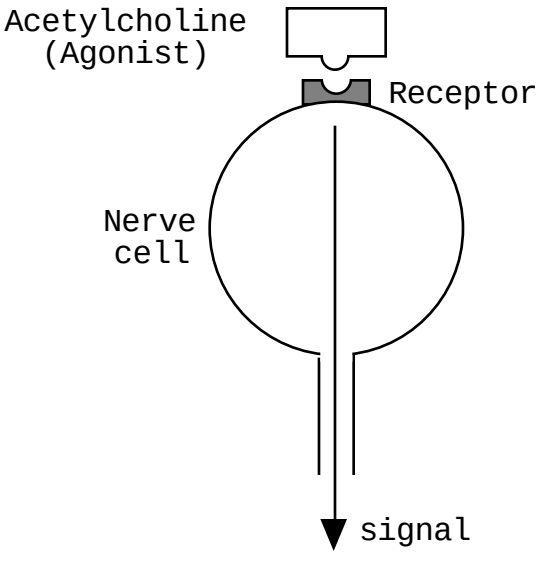


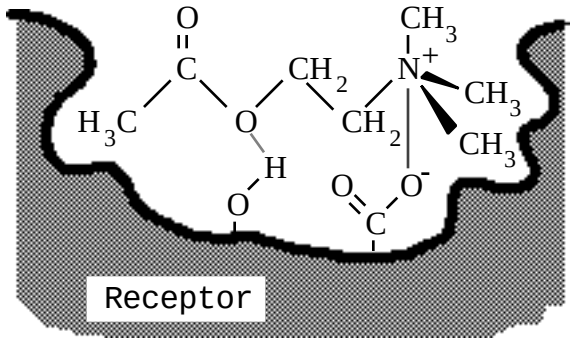
A consideration of the role played by agonists and antagonists in nerve cells should make this clearer.

Acetylcholine



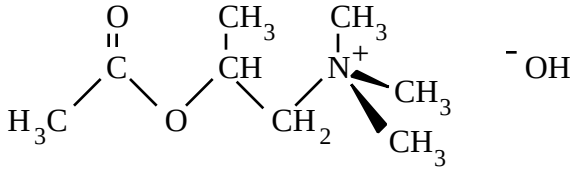
is a natural agonist which causes a signal to pass along a nerve. The agonist fits into grooves and bonds to active sites on the receptor molecule:





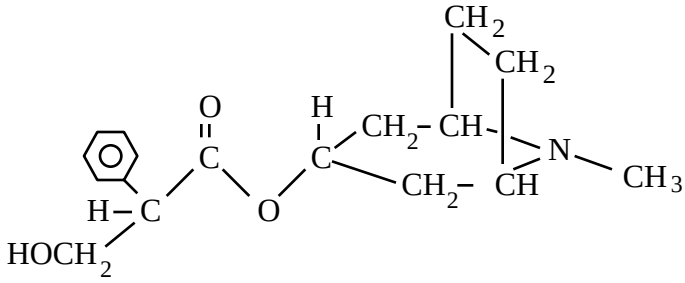
Agonist drugs can be given which mimic the action of the natural agonist and therefore enhance the body's natural response

e.g. Methacholine, given to reduce blood pressure, has a similar shape and pharmacophores as acetylcholine



and is therefore able to fit into the receptor and produce a response just like acetylcholine.

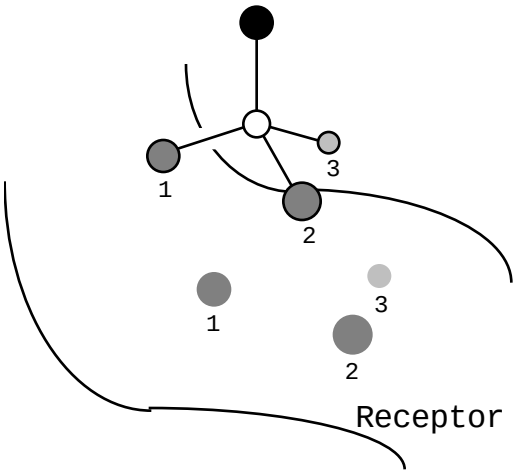
Atropine, given to dilate the pupils of the eye, is an acetylcholine antagonist:



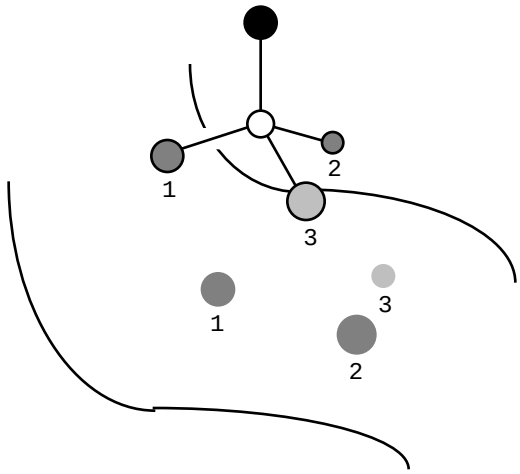
It is able to bond to the receptor because its shape is similar to acetylcholine.

Chiral Drugs

When the molecules of the drug are chiral, the receptor proteins are 'stereospecific' - they accept either the (-) or (+) isomer but not both.



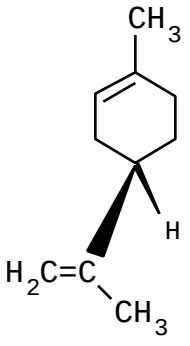
Groups 1,2 and 3 on the receptor are able to bond to the respective groups 1,2 and 3 on one isomer of the chiral molecule.



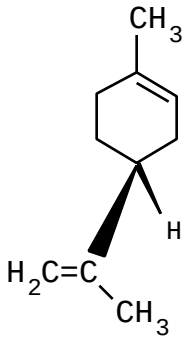
Groups 1,2 and 3 on the receptor are unable to bond to the respective groups 1,2 and 3 on the other isomer of the chiral molecule.

It is therefore not surprising that the (+) and (-) forms of drugs, or any other substrates, have very different effects on our bodies.

Example 1.



(+)-Limonene
(smells of oranges)

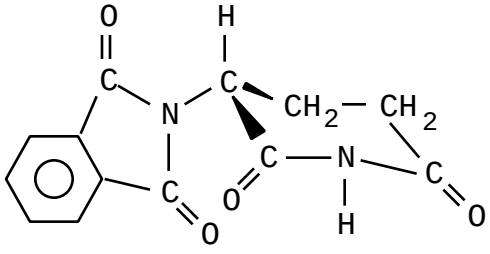


(-)-Limonene
(smells of lemons)

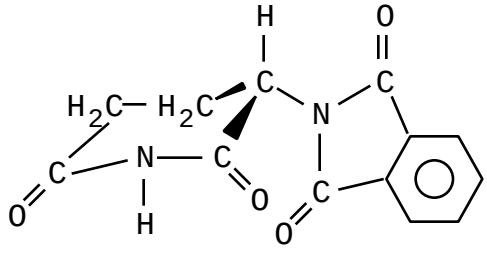
Example 2.

(±)-Thalidomide was once given during pregnancy as a sedative.

Doctors were unaware that only the (+) form had a sedative action; the (-) form caused defects in the unborn child!



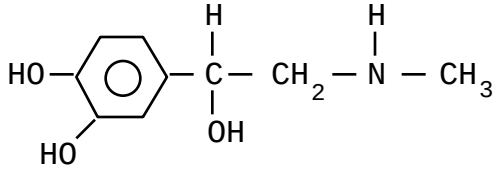
(+)-Thalidomide



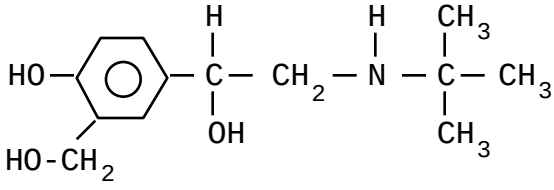
(-)-Thalidomide

Other Interesting Drugs

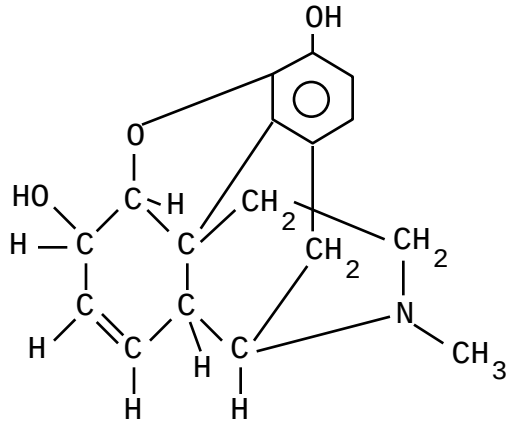
Adrenalin A natural body agonist which causes a rise in blood pressure and a racing heart



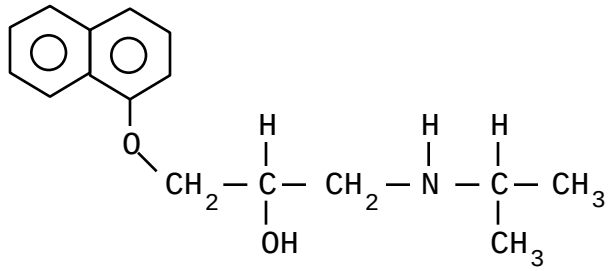
Salbutamol An agonist used in the treatment of asthma



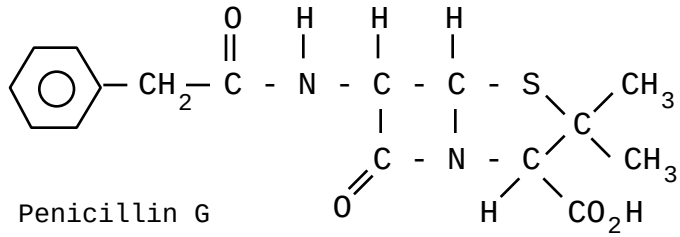
Morphine An agonist which reduces pain (analgesic).



Propanolol An antagonist which blocks access of adrenalin and therefore lowers blood pressure. It is used in the treatment of heart disease.

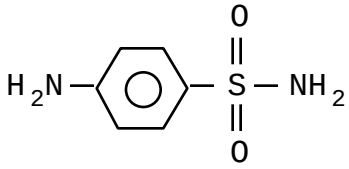


Penicillin An antagonist which kills bacteria (Antibiotic)



Penicillin G

Sulphanilamide An antagonist which kills bacteria (Antibiotic)



N.B. Both Penicillin and Sulphanilamide block enzymes in the bacteria which cause disease.