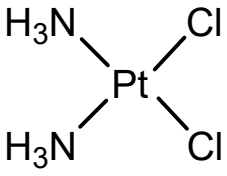
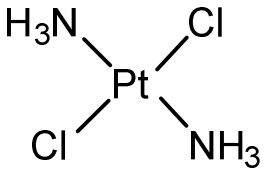
TC5 - Cisplatin

Cisplatin exists as a **square planar Pt^{2+} complex**, with the formula $Pt(NH_3)_2Cl_2$. It is well known as being one of the most effective drugs used in **chemotherapy** to treat **cancers**. In cisplatin, both of the Cl groups are next (**cis-**) to each other, and so are the NH_3 groups. There is an isomer of cisplatin, called **transplatin**. In transplatin, the Cl groups are opposite (**trans-**) each other, and so are the NH_3 groups. These two simple structures have the same formula, and therefore are **isomers** of each other, but they have very **different chemical effects**. Although cisplatin is a potent anti-cancer drug, transplatin has no anti-cancer effects.

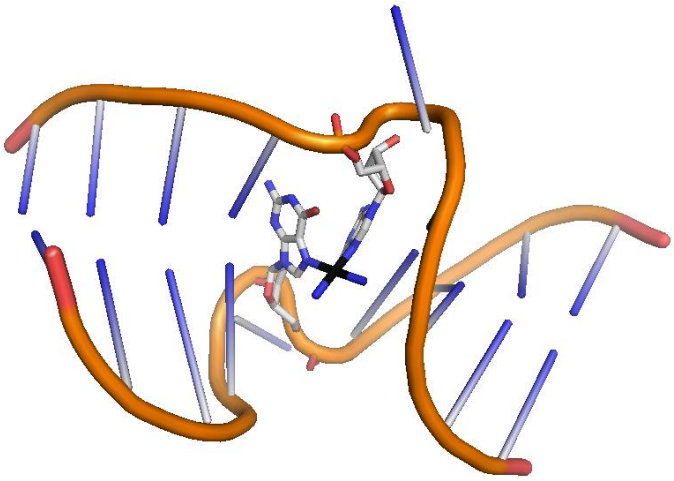


Cisplatin



Transplatin

The tumours which form in cancer are effectively large masses of cells which shouldn't be there. These new cells grow when the mechanism which replicates DNA goes into override, and new DNA, and new cells, develop into large tumours. Cisplatin works by **binding to DNA**, and stopping it from replicating, which stops the tumours from growing. One problem with this is that it stops the replication of normal cells too, so can have many unwanted side effects across the body. As with any medicine, these **side effects have to be considered** when treating a patient. Ideally, the **smallest possible dose** will be used, and it will be **targeted** to the cancerous areas.



1a2e_cisplatin_bound

When cisplatin binds, it loses its Cl groups, and replaces them with bonds to nitrogen atoms in **guanine** through the **nitrogen lone pairs**. This kinks the DNA structure, and **prevents it from replicating**. The isomeric structure is absolutely critical in this. If transplatin was used instead, then the two Cl groups which are lost will be opposite each other, and unable to bind in the arrangement shown. **Therefore, transplatin cannot act in the same way, and cannot treat cancers.** It's worth remembering that such a small change in the structure of a relatively simple molecule can make a huge difference! It's often not enough to just know a chemical formula, but its physical structure too. This is especially important for chemists synthesising drugs like this, because the wrong isomer will make a big difference to the effectiveness of a treatment.

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