

DNA binding by the Cro protein

PDB 3CRO

Bacteriophages (or simply phages) are viruses infecting bacteria. Some phages have two life cycles inside bacteria: first, they go through the *lysogenic* life cycle, which results in the multiplication of phages without killing the bacterial host. Then, the phages enter the *lytic* life cycle, where they kill the bacterial host and are released into the environment, ready to infect more bacteria.

Phages need to make sure they switch from the lysogenic to the lytic cycle at the right time, and therefore that switch is tightly regulated. One of the proteins involved in that regulation is the Cro repressor, which binds phage DNA in a specific place.

Load PDB 3CRO, which contains the complex formed by Cro and DNA.

The amino acid sequence of Cro has a slightly peculiar numbering: it is based on the sequence of another, related protein, which is why the first two positions are numbered -1 and 0.

How many Cro molecules are there in the Cro/DNA complex? Which level of structure (from primary to quaternary) does this observation correspond to?

Two Cro molecules bind DNA together: Cro forms a homodimer (quaternary structure) even though chain R in this structure lacks the last two residues compared to chain L.

Describe the secondary structure of Cro (i.e. number of α -helices, β -strands, etc.).

Cro contains 5 α -helices and 6 coil regions/loops (and no β -strands).

Colour residues **Thr-16** to **Ala-36** with a different colour for each secondary structure element.

*What secondary structure elements are present in the region of **Thr-16** to **Ala-36**?*

Two α -helices flanking a loop (or coil region).

This region forms a structural motif commonly found in DNA-binding proteins: a **helix-turn-helix**. One of the two helices is responsible for binding to specific base pairs, and is called the *recognition helix*.

Based on the structure, which helix is the recognition helix, able to recognise a specific DNA sequence?

The second helix (from Gln-28 to Ala-36) is the recognition helix.

Make a figure showing the structure of the Cro *helix-turn-helix* motif and how it binds DNA as in Figure 9.

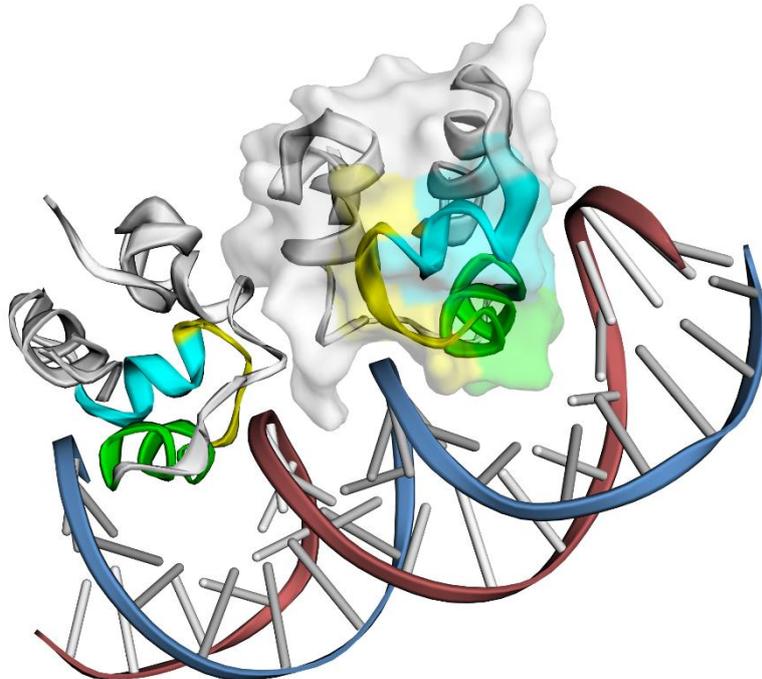


Figure 9 | The page Cro repressor bound to DNA with one of the two monomers as a surface. The *helix-turn-helix* motif is highlighted in cyan (helix from Thr-16 to Thr-22), yellow (turn Lys-23 to Lys-27) and green (helix from Gln-28 to Ala-36).