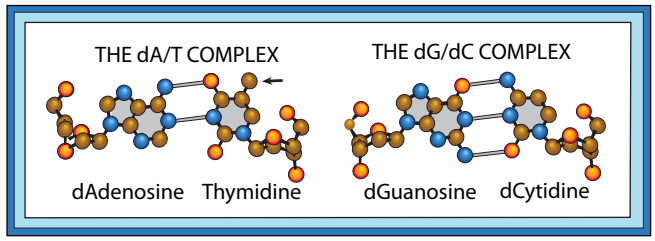
Deoxyribonucleic Acid - DNA

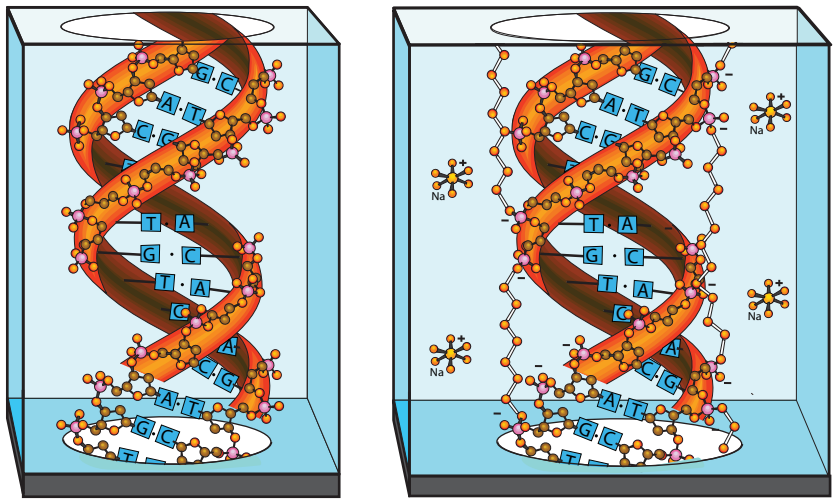
Prior to the formation of enzymatic proteins, catalysis of reactions by nucleic acids was relatively slow. Surrounded by cations, nucleic acids had no broad hydrophobic surfaces. Enzymatic proteins performed cleavages much more efficiently but threatened to destroy single-strand mRNAs which coded protein production. However, other enzymes appeared which could remove one of the oxygens from the ribose rings of nucleotides. When these deoxynucleotides coupled together, they produced a new code-storing nucleic acid: DNA.

As illustrated on the right, the nucleotides still formed selective complexes with each other but, with two less hydroxyl groups per pair and the addition of a methyl group to the uridine ring to form **Thymidine,** the central core of DNA was much more hydrophobic and stable.[55, 56]



With a more compact, less-hydrated central core, **Deoxyribonucleic Acids** began to form double helix coils with such high stability that enzymes were required to separate them.[56]

However, the picture of double-helix DNA, which is illustrated on the right and has become the symbol of modern molecular biology, is not very accurate because 13 water molecules per base pair are required to maintain it in that structure. If the helix is dehydrated, it forms a different helix which is not in living cells.[54]



When Watson and Crick, Linus Pauling and a number of other investigators were attempting to obtain an interpretable X-ray diffraction pattern of DNA, it was Roselind Franklin at Kings College in London who, by spraying a sample with water, obtained the pattern which was used by Watson and Crick to complete their model and publish their classical paper.[55] Unfortunately, they did not mention the extreme importance of water in maintaining the spatial structure of the helix and did not give Roselind credit for her contribution.

Although the model pictured on the right is more complex, it most likely is more accurate because infrared and NMR anayses indicate that the water surrounding B-DNA is not liquid, it is "Ice-like". [10,54] Based on the TLH hypothesis, linear segments of DNA helix in the living cell are always in motion with transient linear elements of 5 to 7 water molecules bridging between phosphates across the wide groove and 3 to 4 across the narrow groove to permit delocalization of the high negative charge. Linear elements also form in the large groove and between the base pairs and they continually form kinetically around the helices in covalent ice-like forms to transfer charge outward to sodium ions which, by being hydrated spherically, are kept out away from the helix the same as they are when water begins to form covalent cubic structuring as water begins to freeze.[26, 56]