Nucleosome interactions, chromatin structure, and gene activity

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The 30 nm thick chromatin fiber seen in the eukaryotic nucleus is composed of arrays of nucleoprotein subunits (nucleosomes) that have been packed to form a helical array. Some of the forces that stabilize the nucleosome structure can be determined by physical methods. Chemical probe experiment show that the major contacts holding the DNA to the surface of the nucleosome involve the phosphodiester groups. Application of simple ion binding theory for polyelectrolytes leads to the further conclusion that much of the DNA is held to the nucleosome surface by only a small number of interactions. We have also used electric dichoism to determine the orientation of nucleosomes within the 30 nm fiber. The understanding of the physical properties of bulk chromatin has recently permitted us to begin comparative studies of the properties of chromatin in the neighborhood of specific genes. We discuss recent results concerning the organization of chromatin in the neighborhood of a particular gene, the adult beta globin gene of chicken, in cells which are actively synthesizing that protein. One region in the vicinity of this gene appears to be free of nucleosomes, but in many other respects the gene is packaged as "normal" chromatin.