The two meters of DNA in every human cell must be tightly packaged in order to fit in the nucleus and to protect the genetic information. NAP1 (Nucleosome Assembly Protein 1) is a histone chaperone that helps assemble and disassemble the nucleosomes used to package this DNA. A nucleosome consists of a core of eight positively charged proteins called histones around which are wrapped 147 base pairs of DNA. The eight histones are actually four heterodimers; there are two H2A/H2B dimers and two H3/H4 dimers. The histones' positive charges are attracted to the DNA's negative charge; this attraction causes the DNA to form left-handed supercoils around the histones. The experiment shown on our poster demonstrates that, in vitro, NAP1 can assemble nucleosomes on DNA without the help of other chaperones. Histone chaperones like NAP1 are essential in cells because without them the first step in protein synthesis, transcription – the process of making RNA copies of the genes encoded in DNA – cannot occur because RNA Polymerase needs to access the DNA strands. This would not be possible if the DNA remained supercoiled around nucleosomes. Nucleosomes must also disassemble for replication – the process of copying DNA by DNA Polymerase – to occur. Replication is important in cell division because the DNA must be copied and distributed to the two daughter cells. NAP1 is so vital to these cellular processes that evolution conserved it across organisms from one-celled yeast to humans with trillions of cells.

The above experiment shows that NAP1 can assemble nucleosomes on DNA in vitro. The protocol is to add increasing amounts of histone and of NAP1 to circular, covalently closed DNA in the presence of topoisomerase 1 and incubated at 35°C for 60 minutes. The reaction is stopped by adding a SDS (sodium dodecyl sulfate) containing buffer, which denatures the proteins (both histones and topoisomerase 1) leaving the DNA free from both of them. The DNA is then electrophoresed on 1.2% agarose at 80 volts for 10 hours at 4°C. The gel is stained with ethidium bromide and photographed (See photo above).

The Z-Corp printer featured above builds 3-dimensional rapid-prototype models of molecules by repeatedly printing on thin layers of plaster instead of paper with a dyed glue-like spray.