Our model was made on the Z-Corp printer. The Z-Corp printer is like a normal inkjet printer. It has three print heads with different colors: cyan, magenta, and yellow. In addition to these print heads, the Z-Corp printer has a binder print head. The only difference between the Z-Corp printer and a regular printer is that it uses plaster powder instead of paper to print three-dimensional models. The Z-Corp printer achieves this by printing many layers. Programs like RasMol and AutoCAD 2000 can send images of 3-D objects to the printer. The Z-Corp printer then makes the model one layer at a time.

**Abstract**

The purpose of the St. Dominic SMART Team project was to design a physical model of the enzyme Sir2 Histone H4 Deacetylase using data deposited in the Protein Data Bank and a molecular visualization program called RasMol. The designing process helped us to learn about this important enzyme’s structure, its function in the cell, and also about the chemical reaction it catalyzes. Our mentor, Dr. Vaughn Jackson, helped us understand how Sir2 controls DNA expression by removing acetyl groups from the lysine 16 of the histone H4 tails of nucleosomes. Removing an acetyl group from lysine changes its charge from neutral to positive. This positively charged histone tail is attracted to the negatively charged backbone of the DNA wrapped around the histones. Scientists have known for some time that acetylated histone tails are associated with active DNA and deacetylated tails with inactive or silent DNA.

Our enzyme, Sir2, belongs to an important family of enzymes called sirtuins. Sir2 is the yeast homologue of human Sir2p.2 All Sir2 deacetylases have amino acid sequences that are very similar in all organisms from bacteria to humans. They all remove acetyl groups from acetyllysine sidechains on the proteins that they target. They all use NAD+ to accomplish this.

Sir2 enzymes are very important to cells because they are involved in essential activities such as turning off genes, promoting the repair DNA, maintaining genome stability, and in cell metabolism. They have even been linked to increased lifespan. For example, scientists have discovered that restricting calories can extend the life of several research organisms. They noticed that calorie restriction causes cells to have very active Sir2 enzymes. Maybe, in the future, drugs that activate Sir2 deacetylases may become a way to stay young! Doctors are already using Sir2 activators in research trials to treat the cancers, lymphoma and leukemia.

**Chemical Reaction**

- **Reactants/Substrates**:
  - NAD+
  - Sir2 Histone H4 Deacetylase
  - Acetyllysine 16 on Histone H4

- **Products**:
  - Nicotinamide
  - Acetyl Group
  - 2′-O-Acetyl-ADP-Ribose

**Substrate and Inhibitor**

- **Normal Substrate**: NAD+
- **Inhibitor**: Carba-NAD+

**PDB File: 1SZC**

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**Making the Model**

Our model was made on the Z-Corp printer. The Z-Corp printer is like a normal inkjet printer. It has three print heads with the colors cyan, magenta, and yellow. It also has a binder print head. The only difference between the Z-Corp printer and a regular printer is that it uses plaster powder instead of paper to print three-dimensional models. The Z-Corp printer does this by printing many layers. Programs like RasMol and AutoCAD 2000 can send images of a 3-D object, like a protein model, to the printer. The Z-Corp printer then makes the model one layer at a time.

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