The objective of this project was to alter the sugar D-ribose, a major component of the chemical structure of RNA, through the use of carbohydrate chemistry. The changes would be to alter the hydroxylated carbons to become positively charged primary aminated carbons in order to allow for favorable molecular interactions between the compound in question and the negatively charged backbone of DNA. Once DNA is added to the compound, cells will be transfected with the vehicle and the DNA in order to make the cell express genes of interest to mark successful transfection by the vehicle.

Insofar there has been much slow going towards the goal. A glove box is needed for use with the highly reactive reagents used in the chemistry. The lack of easy access to an on-campus glove box for reactions of propylamine as the middle step towards attaching primary amines to the sugar molecule has prevented the next step of the process. Only recently was the suggestion of a schlenk line to afford an oxidation free environment for completing the chemistry investigated as a possible unit for operation. Once these parts are ordered the next step will be to employ the help of Scott Grayson in the chemistry department for the assembly of the schlenk line and possible supervision of the more reactive parts of the process.

The first part of the reaction process has been completed and shown to work, or at least give favorable results suggesting the viability of the chemistry. This reaction involves mixing Pyridinium Chlorochromate (PCC) with the D-ribose sugar in a solvent of acetone to create a ribose base ring with carbonyl bonds replacing the original secondary alcohols to make the ring contain a number of ketone parts. PCC is a perfect oxidizing agent in that it stops the reaction at the ketone formation step allowing for the addition of the reactive propylamine for attachment of nitrogen atoms in the next step. The reaction of PCC with the secondary alcohols follows as such:

$$\text{PCC} + \text{D-ribose} \xrightarrow{\text{acetone}} \text{ribose base ring}$$

This reaction was carried out and proved to work effectively on the first step towards the ultimate primary aminated ribose. Upon adding the PCC to the acetone solvent the acetone turned a clear but orange color as a result of the PCC. After this it was added to the ribose sugar and swirled in a flask for 2 minutes with no recordable evidence of a chemical reaction. The ribose would not dissolve but rather sat at the bottom of the flask unreactive. However, when left to sit at room temperature for about 20 minutes evidence of reaction began to show. In the reaction sequence shown above, the chromate is liberated from the PCC and combines with oxygen to form a black substance that is evidence of the reaction proceeding forward. As time wore on and the flask was swirled more, an increasing amount of this substance appeared in addition to coloration of the ribose itself. This coloration of the ribose can either be attributed to this black substance being mixed in or the color of the ketonated sugar being a dark brown color. Separation is to be carried out through the differential solubility of secondary alcohols and ketones using other organic solvents for purification.

There are a number of improvements that could be made upon this initial reaction step that would afford more product with better yield. One possibility is to heat the reaction vessel to increase the amount of interactions the PCC has with the ribose at a quicker rate. Also, the possibility of adding molecular sieves and inert dehydrating products could improve the process by making the reaction cleaner and faster by adsorbing the oxidized chromate byproduct and allow for water to be drawn off driving the reaction forward.