**BACKGROUND**

Based on a previous study on the Beta Amyloid peptide, it was found that the conformation of the peptide (protein) was able to change with external conditions such as pH. We decided to test the conformational changes with pH hopping of the spike protein of SARS-CoV-2. The spike protein is the surface protein of SARS-CoV-2 which initiates an immune response and binds to the receptors on the cell membrane. At a pH of 10, which is a basic condition, the receptor on the spike protein would be facing downwards and not be able to form any gold aggregations. In a pH of 3, which is an acidic condition, we would expect either the “parallel in opposite direction” or “head to head dimer” which would both form gold aggregation.

**METHODOLOGY**

We had nine different sizes of the gold nanoparticles that were prepared and used to observe the shift in the peak position wavelength which was due to external factors such as pH. We changed the pH by adding HCl, which is a strong acid, and NaOH, which is a strong base maintaining it at a pH of 3 and of 10 for every other sample up to 20 samples. Observing the position of the maximum wavelength on the UV-Vis spectrophotometer, we were able to interpret the reversibility of the protein.

**RESULTS**

When the spike protein is bound to 60 nm gold nanoparticles (Fig. 5) the trends are different compared to the 80 nm and 100 nm gold nanoparticles aggregates. In the case of 60 nm gold nanoparticles, the red shift does not follow the trend where as temperature increases so does the overall red shift. Instead, the general slope of the 15 C line is higher and more red shifted that the 25 C line. In addition, the amplitude of oscillation seems to remain about the same and does not show a dampening effect like what occurs with the 80 nm and 100 nm gold nanoparticles.

**DISCUSSION**

The trends shown in Figures 3, 4, & 5 suggest that there is a temperature dependence on the folding conformation of the spike protein. The difference in trends exhibited in the 60 nm gold nanoparticles suggests that the aggregation of the gold nanoparticles and spike protein also depends upon the size of the gold nanoparticles and can be affected by many different factors working together.

The type of oscillation exhibited in each of the graphs means that the spike protein exhibits semi-reversible conformation changes. Generally, at more acidic pHs (even operation numbers) the aggregation of the gold nanoparticles and spike protein also depends upon the size of the gold nanoparticles and can be affected by many different factors working together.

These results are important because they can be used to implement efficient storage practices of the virus. If the spike protein is tightly bound and aggregated with the gold nanoparticles, then it is not able to be spread. Understanding the optimal conditions under which the spike protein will be bound to other proteins and gold nanoparticles is necessary for this.

Further research should be done to further investigate the temperature dependence at additional temperatures and additional sizes of gold nanoparticles. In addition, these methods can be used to test aggregation of additional virus surface proteins to gold nanoparticles.

**REFERENCES**
