Page 1:
Hello everyone, my name is Lucy Shon. I'm currently a senior majoring specialized chemistry . Today, I'm going to talk about my research which is "The single-chain nanoparticle Delivers a partner enzyme for a concurrent and Tandem Catalysis in Cells."

Page 2:
Our Single-chain nanoparticles have been developed with Ruthenium tris bi-pyridine as an enzyme mimic photocatalyst.
The synthesis of Ruthenium Single Chain Nanoparticle is straight forward. The synthesis was performed in water by adding water soluble polymer P1 and Ru tris-bipyridine diyne **1**.
In fact, our Ruthenium Single Chain Nanoparticles have been shown to penetrate the cell membrane and perform reactions inside cells, especially photocatalytically reducing aromatic azido group to amino group.

Also, the nanoparticles can co-deliver an exogenous enzyme beta-galactosidase into cells and reside in endosome.

There are several reasons behind why we chose Ru tris- bipyridine : the Ru(bpy)3 itself is very stable, it has very poor cell permeability and shows low reaction rate in biological condition. So, it is comparable to our Ruthenium Single Chain Nanoparticle.

Page 3:
The catalytic activity of Ruthenium Single Chain Nanoparticle was tested. If Ruthenium Single Chain Nanoparticle could catalytically deliver the reducing agent in this case Sodium ascorbate. The compound 2 will convert to highly fluorescent compound 3, which is Rhodamine 110, in the presence of iridescence.

The Ruthenium Single Chain Nanoparticle was able to photo catalytically reduce aromatic azide on 2 to 3 and it was confirmed by increasing fluorescence intensity. In 10 min time period, more than 97 % of 2 was converted to 3 in presence of single chain NPs

Also, our Ruthenium Single Chain Nanoparticle was able to penetrate through the cell membrane of HeLa cells and perform reduction reactions intracellularly.
As shown in the diagram the Rhodamine 110 was fluorescent inside the cell, especially in the endosome. Simultaneously, the Ruthenium Single Chain Nanoparticles were also present in cells, indicated by the red fluorescence.

Page 4:
In addition, it was found that beta galactosidase binds to a few Ruthenium Single Chain Nanoparticles, in this case 2-3 SCNP and resides in the endosome. As shown on the top-right diagram the beta-galactosidase, which is fluorescently marked and Ruthenium Single Chain Nanoparticles fluorescent overlap, showing that the Signle Chain Nanoparticle-enzyme complex were co-delivered into cells

Intracellularly, the Signle Chain Nanoparticle-enzyme complex will perform concurrent or tandem reactions.
To confirm, the dual catalytic activities were observed in HeLa cells.
As expected, Single Chain Nanoparticle reduced aromatic azido groups to amine and generate 3, which is rhodamine 110
Beta-galactosidase performed enzymatic reactions, creating a coumarin derivative, which creates blue fluorescence
And our Ruthenium Single Chain Nanoparticle is fluorescent in red.

As you can see blue fluorescent from coumarin derivative, green fluorescent from Rhodamine 110 and red fluorescent from our Ruthenium Single Chain Nanoparticle all overlap and reside in endosomes.

Therefore, endosomes are engineered as artificial organelles, which could perform chemical and biological reactions intracellularly.

Page 5:
I would like to thank professor Zimmerman for giving me an opportunity to work in lab. Also, I would like to thank my mentor Dr. Junfeng Chen and grad student Ke Li for letting me to be part of the project and rest of our Zimmerman group members.

Thank you so much for listening.