Fluorescence Microscopy
Cells were seeded on cover slips and exposed to gold nanoparticles, then fixed and stained for VE-cadherin and actin. Fluorescence microscopy was used to visualize the expression of VE-cadherin and actin in the samples. Images of samples with and without gold nanoparticles were compared for morphology.

Trans-endothelial Electrical Resistance (TEER)
The Trans-endothelial Electrical Resistance measurement provides a quick and easy evaluation of the integrity of a monolayer of cells. Human umbilical vein endothelial cells (HUVEC) were seeded on transwells (Fig. 2) and cultured until fully confluent, then the electrical resistance was measured.

Colorimetric Assays
The CCK-8 assay was used for testing for cytotoxic effects of compounds by measuring cell proliferation. Reactive oxygen species (ROS) are formed as a natural byproduct of the normal metabolism of oxygen and have an important role in cell signaling and homeostasis. During times of environmental stress (e.g., exposure to nanoparticles), ROS levels can increase dramatically due to significant damage to cell structures. Studies were conducted to quantify cell viability and ROS levels when exposed to different concentrations of gold nanoparticles with the properties listed in Table 1.

Exposure to nanoparticles occurs through numerous routes, yet the highest potential for toxicity occurs when nanoparticles enter the bloodstream and are able to circulate to systemic tissues within minutes. All blood-contacting surfaces are lined with endothelial cells (Fig. 1) that play a vital role in the transmittance or clearance of compounds from the blood.

Methods
Exposure to nanoparticles occurs through numerous routes, yet the highest potential for toxicity occurs when nanoparticles enter the bloodstream and are able to circulate to systemic tissues within minutes. All blood-contacting surfaces are lined with endothelial cells (Fig. 1) that play a vital role in the transmittance or clearance of compounds from the blood.

Results
Fig. 4 shows decreased TEER of human endothelial cells exposed to 20 nm nanoparticles (blue) compared to control (gray) for 60 or 120 minutes and the subsequent recovery in resistance of the monolayer after particles are removed over 48 hours.

Discussion
• Gold nanoparticles can adhere to endothelial cells or be taken up by endothelial cells easily.
• Exposing vascular endothelial cells to gold nanoparticles reduces the barrier function of endothelial cell monolayers.
• Exposure to gold nanoparticles affects the expression of VE-cadherin, actin, and cell shape, which may change the cause of strain energy.
• Exposure to gold nanoparticles increases the ROS level in cell culture.
• Cytotoxicity of gold nanoparticles is size dependent and surface modification dependent. 5 nm nanoparticles are more toxic than 20 nm particles. Plain particles show toxicity while PEGylated particles don’t.

Future Work
• A library of gold nanoparticles (different sizes, coatings, concentrations, etc.) need to be examined.
• Studies will be conducted with the presence of inflammatory factors.
• The TFM experiment will be repeated, different nanoparticles will be tested. The mechanism needs to be studied.