# CALIFORNIA STATE SCIENCE FAIR
# 2015 PROJECT SUMMARY

**Name(s)**

**Maggie S. Chen**

**Project Number**

35168

**Project Title**

## 3D Printing of a Hydrogel Patch with Drug-Loaded Nanoparticles for Combinational Therapy

**Abstract**

**Objectives/Goals**

The goal of the project is to make a multilayer hydrogel patch with drug-loaded nanoparticles using 3D printing for combinational therapy. The hydrogel structure provided a supporting platform for holding the nanoparticles, while the drug-carrying nanoparticles offered controlled release of the drug. Since the patch was created through a 3D printer, it could not only be made for patient-specific sizes, shapes and drug doses, but also be made as a multilayer structure with each layer loaded with different drugs for combination therapy.

**Methods/Materials**

1)Nanoparticle Synthesis: Nanoprecipitation Method; Double Emulsion Method
2)3D Printing: 20% PEGDA (Polyethylene (glycol) Diacrylate) + 0.5% LAP (lithium acylphosphinate) as the photoinitiator
3)Drug Release Testing

**Results**

*Both the double emulsion and nanoprecipitation methods produce stable nanoparticles. These nanoparticles can be encapsulated in the hydrogel.
*3D printing of the patch allowed for any computerized design and a multilayer structure.
*The nanoparticles were able to encapsulate drug molecules, and were able to release them from the hydrogel platform in a more controlled fashion than the free drug particle release from a hydrogel platform.
*The multilayer drug release proved to be controlled and staggered as well.
*The hydrogel patch proved to be effective in stopping the growth of E. Coli bacteria.

**Conclusions/Discussion**

The hydrogel patch provides a stable, controlled, and localized drug delivery platform. The nanoparticle encapsulation system is effective in staggering release rate, and thus can be used for controlling drug release. 3D printing allowed the nanoparticles to be encapsulated in a designer patch. Computer-control allows for any computerized design, and multiple layers can be printed. Combining nanoparticles with 3D printing allows for a multilayer patch with different drug nanoparticles in each layer. Thus, combinational therapy is achieved, and the drug release is controlled and localized. This hydrogel patch has been proven to have the ability to release multiple kinds of drug particles, and is effective in stopping the growth of E. Coli bacteria.

**Summary Statement**

I created a multilayer hydrogel patch with drug-loaded nanoparticles using 3D printing for combinational therapy.

**Help Received**

Used lab equipment at University of California, San Diego under the supervision of Professor Liangfang Zhang.