# CALIFORNIA STATE SCIENCE FAIR
# 2016 PROJECT SUMMARY

**Name(s)**

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**Project Number**

**J1010**

**Project Title**

## A Bluer Ocean: Replacing Microplastics with Water-Soluble Bioplastics

**Abstract**

**Objectives/Goals**

An estimated minimum of 5.25 trillion microplastics weighing 268,940 tons is in our oceans. By 2020, that number is projected to increase tenfold. Microplastics lead to detrimental health effects across the food web (eg. impaired neurodevelopment) due to their ability to adsorb toxins, which bioaccumulate in living tissue. Bioplastics could solve the microplastic crisis, but most are made of insoluble materials. The primary objective of my project is to create a strong, flexible, water-soluble bioplastic to reduce the rising amount of toxic microplastics in the ocean. Bioplastics consist of a polymer, plasticizer, and additive. In this project, pectin, a natural gelling agent found in cell walls, will be the polymer, and glycerol, a plant derivative, will be the plasticizer. Calcium carbonate will be the additive to add thickness and strength. The parameters of strength, flexibility, and water-solubility will be evaluated.

**Methods/Materials**

Pectin ($C_6H_{10}O_7$) was extracted from Citrus sinensis peels and precipitated into a gel with isopropyl alcohol. Grinding eggshells yielded calcium carbonate ($CaCO_3$). Calcium carbonate and glycerol ($C_3H_8O_3$) were folded into the pectin precipitate and set in a 50°C temperature chamber.

**Results**

After each trial, the results were observed and the procedure was revised. A ratio of 20 mL pectin precipitate to 2.5 grams calcium carbonate yielded best textural results (not thin or crumbly). Glycerol did not affect texture and it increased flexibility. As the amount of glycerol increased, the strength decreased, which can accommodate the uses of different products. All pectin in the bioplastics dissolved in 3 days, proving solubility.

**Conclusions/Discussion**

Pectin, calcium carbonate, and glycerol can be used to make a strong, flexible, water-soluble bioplastic. It could also aid in reversing negative effects of ocean acidification on mollusks and corals. Calcium carbonate from the bioplastic would disassociate into $Ca^{2+}$ and $CO_3^{2-}$, which could be used by mollusks and corals to grow. By dissolving in the ocean instead of adsorbing toxins, the bioplastic reduces risks of toxins accumulating and leading to adverse health effects. Further research includes finding other uses for this bioplastic and pectin precipitate. Pectin has been found to induce apoptosis in two lines of cancer cells, and polymers are gaining popularity as favorable mechanisms for drug delivery.

**Summary Statement**

I used pectin, calcium carbonate, and glycerol to create a strong, flexible, and water-soluble bioplastic that could potentially reduce the rising amount of toxic microplastics in the ocean.

**Help Received**

Mrs. Iyer, my science teacher, was my mentor, and my parents provided the money for materials.