# CALIFORNIA STATE SCIENCE FAIR
# 2015 PROJECT SUMMARY

**Name(s)**

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**Project Number**

**J1313**

**Project Title**

## Splat: A Ballistic Pendulum Study of How Clothing Fabric Properties Affect Momentum and Energy Transfer of Paintballs

**Abstract**

**Objectives/Goals**

The purpose of this work was to determine the best materials to use for protective clothing against paintballs. This project involved three separate experiments. In Experiment 1, I measured the momentum transferred by the impact of regulation paintballs fired from a paintball marker into various protective fabrics. In Experiment 2, I measured how much damage a regulation paintball would cause to simulated flesh through various fabrics. Experiment 3 was a repeat of Experiment 2 using frozen paintballs.

**Methods/Materials**

Paintball velocity was measured using an optical ballistic chronograph. I simulated human flesh with a carefully controlled ballistic clay. This allowed me to simulate impact welts or #target lesions# in the clay. Momentum transfer was measured using a ballistic pendulum.

**Results**

My results for Experiment 1 are: i) both canvas and leather when used in combination with padding produce the greatest momentum transfer to the pendulum, ii) terrycloth and t-shirt material provide the same momentum transfer as the control (bare flesh), and iii) thick single materials like leather and canvas provide the least momentum transfer corresponding to the shortest pendulum swing. My results for Experiment 2 are: i) that bare flesh (the control) and the lightweight fabrics provide about the same flesh damage and little overall protection, while ii) the heavy materials, either in single or double layers provide significant protection (less flesh damage). My results for Experiment 3 are: i) frozen paintballs don#t seem to provide significantly more flesh damage in the simulated flesh than regulation balls when traveling at the same speed, but ii) the frozen paintballs travel faster and broke my ballistic pendulum.

**Conclusions/Discussion**

From these results I conclude that double layer materials do not provide a significant benefit relative to heavy weight single layer fabrics such as canvas and leather, but lightweight materials such as terrycloth or t-shirt provide virtually no additional protection relative to bare flesh. Frozen paintballs should be outlawed primary because they travel 20 m/s faster than regulation paintballs and given that they broke my plywood apparatus are likely to be very dangerous to people.

**Summary Statement**

The purpose of this work was to determine the best materials to use for protective clothing against paintballs.

**Help Received**

My family helped me conduct my experiment.