



# SOCIETY OF PHYSICS STUDENTS

An organization of the American Institute of Physics

## Marsh W. White Award Proposal

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<b>Project Proposal Title</b>	Drew Physics Day
<b>Name of School</b>	Drew University
<b>SPS Chapter Number</b>	1612
<b>Total Amount Requested</b>	\$500

### Abstract

The Drew University SPS wants to inspire a love of the natural world in middle school and high school students through the wonders of exciting physics demonstrations that will empower them and invigorate them to pursue the sciences.

# Proposal Statement

## Overview of Proposed Project/Activity/Event

The Drew Physics Day will be an effort to encourage middle school and high school students from a few local districts to pursue the sciences by emphasizing how fun and interesting the sciences are, specifically physics. The Drew SPS hopes to impact at least 100 students. The Drew Physics Day is designed to be reproducible so that as many students as possible can experience it. The Drew Physics Day also hopes to empower participants to feel that they have the ability to succeed if they pursue a STEM career. The Drew University SPS has seen that many students feel discouraged about their abilities. Our chapter would like to instill in participants that if they enjoy science and are willing to work hard, then they can have a successful and fulfilling career.

The Drew Physics Day will feature a U-Haul Camera Obscura. Participants will be able to sit inside the back of a U-Haul truck where the tailgate will be opened and converted into a pinhole. The students inside the truck, will see the projected image of the environment outside, inverted on the inside of the truck! Students can learn about the optical principles involved in the camera obscura to understand what they are seeing. The Drew SPS advisor, Dr. Bjorg Larson, conducts research on confocal microscopy which directly relates to the principals the students will learn about on the day of the event. This idea was inspired by a YouTube video by the user Physics Girl. The event will also include a 3-Pendulum Harmonograph. Participants will be able to take home a drawing of their own creation from the harmonograph. However, this harmonograph will have a special added feature. One leg will be converted to a double-pendulum to demonstrate chaos. For high school students this will introduce the amazing fact that even though the pendulum is under completely deterministic forces it is practically impossible to predict its motion in the long term. And they can see that the picture drawn by a chaotic harmonograph is not as elegant looking as the regular version. We also would like to demonstrate conservation of momentum in a dramatic fashion. A properly trained demonstrator will use a fire extinguisher to propel themselves. This should catch the attention and imagination of future mechanical engineers and physicists. They students will also receive materials on how to make sure they are well positioned to pursue their interests.

The Drew University SPS has been motivated this year to reach out to other students. Recently we hosted an alumni panel to give advice to current Drew Students about navigating possible career interests and graduate schools and develop a network of contacts for the Physics Department as a resource. In kind, the Drew SPS would like to offer a similar service to students that are thinking about the sciences.

## How Proposed Activity Promotes Interest in Physics

As stated in the overview, the Drew SPS's main goal is to show how truly wonderful physics is and to encourage young people to pursue STEM careers. We are specifically mindful that some students who enjoy science can become discouraged because of the fear that their skills are inadequate. The Drew SPS would like to empower students so that they feel that they can be what they want to be. The Marsh W. White Award would enable the Drew SPS to purchase the necessary equipment to carry out our mission which includes renting a U-Haul, purchasing building materials and a fire extinguisher and folders for informational packets. Many of the members of the organization have felt that when they were in high school, there was a great a demo that caught

their eye and made them seriously consider physics. The Drew SPS wishes to present physics in an exciting, tangible, accessible way for the participants of the program and with the aid of the Marsh W. White Award, it is possible.

## Plan for Carrying Out Proposed Project/Activity/Event

The Drew Physics Day will be headed by Rutendo Jakachira, chapter President, and Matthew Gronert, chapter Vice President with advisement and support from the Drew SPS board and general membership. They will be overseen by Dr. Minjoon Kouh, Department Chair, and Dr. Bjorg Larson, SPS Advisor. They will meet regularly to ensure that tasks are completed professionally and in a timely manner (i.e. schools contacted well in advance, etc.).

The event will be marketed by science teachers in local school districts, as well as advertisements in shops. The partnership with school districts (Madison, NJ, Chatham, NJ, Morristown, NJ) should provide adequate attendance.

The Drew SPS board consisting of 5 members will run the event with the assistance of at least 10 SPS members who can help construct the camera obscura, instruct the students on the underlying physics concepts at a variety of levels depending on the students' ages, and mingle with participants to talk about their path to being a physics major and give advice.

Dr. Larson leads a research group on confocal microscopy which directly relates to the camera obscura. Rutendo Jakachira, Matt Gronert, Luis Duran, Shanjida Khan, Nino Kobishvilli, and Katelynn Fleming have all worked in that lab and can speak to the physical principals behind the camera. Matt Gronert will construct the 3-Pendulum Harmonograph and has studied chaos. All physics students can speak to the principals of conservation of momentum.

## Project/Activity/Event Timeline

The Drew Physics Day will take place on **May 4<sup>th</sup> 2019**

**January 15<sup>th</sup>** - begin contacting community partners

**February 22<sup>nd</sup>** – confirm partners

**March 15<sup>th</sup>** – complete construction of Harmonograph

Meet with partners to coordinate turnout effort

**April 4<sup>th</sup>** – begin advertisement for event

Order U-Haul

**May 1<sup>st</sup>** - prep SPS members for event day

delegate specific day-of responsibilities

**May 4<sup>th</sup>** – meet at Drew University

Set up even (coffee, snacks, demos, etc.)

Have fun! (Day of timing TBD)

In case of rain will host indoors.

## Activity Evaluation Plan

There will be a sign-in sheet to determine the demographics of the participants, in number, age, hometown and email. The Drew SPS will then send a follow-up email asking for participants to evaluate the program, the event administrators, and overall impact. A sample question might be, "How did the Drew Physics Day change your feelings about science?" The Drew SPS will then use this information to shape future events so that there can be continual improvement for the next outreach event.

## Budget Justification

The U- Haul rental cost is expected to be about \$100 after fees. This piece is necessary to create the large camera obscura that a person can go inside. The pinhole aspect of the camera will be achieved via cardboard and will be relatively inexpensive. The following materials are required for the 3-Pendulum Harmonograph:

- 1 3/4" x 3'x3' plywood for table top
- 4 1½" x 1½" x 40" for legs (about 14' total)
- 4 1½" x 8" x 12" for leg braces (about 4' total)
- 4 3/4" x 4' dowels for pendulum and pen lifter
- 1 3/4" x 1½" x 30" oak to cut for pendulum supports, and other
- 1 11" x 11" x 1/8" board for platform to hold paper
  
- 3 3/4" x 5" long metal pipe nipples (plumbing section)
- 3 3/4" to 1" metal pipe bushings
- 3 1" steel clamps
- 4 1¼" x 4" metal plates (or 2 1¼" x 8" plates cut in half)
- 1 large metal washer with 2½" outer diameter, 1" inner diameter, for gimbal
- 1 screw-eye for pen lifter
- various drill bits: 3" circular, 3/4", 1/8", etc.
- various #10 screws (1", 1¼", 1½", 1¾", 2", 3")
- a few thin nails
- tools: drill, saw, hammer, tape measure, file, sand paper, etc.
- 2½ lb weights with 1" hole, 8 to 12 of them
  
- 2 1/2" x 1/4" x 30" balsa (and maybe a spare or two)

- various pens such as: Silver Uni-Ball GEL Impact, and Staedtler Triplus Rollerball
- some string and rubber bands
- paper, 8½" x 11" (or 9" x 12") some black, some white

The estimated cost of these supplies is about \$200. Some of the screws and drill bits are already available in stock of the Drew Physics Department, but specifically the lumber and metal will need to be purchased.

The estimated cost of the fire extinguishers is \$80 for two fire extinguishers. The Drew SPS intends on using the fire extinguishers for multiple demonstrations.

Food and refreshments should be provided at the event to make more enjoyable and social. This would include pizza and soda for all participants. The estimated cost of the food is \$100.

The Drew SPS intends for the funds from the Marsh W. White Award to be used as effectively as possible. Because of this intention, as many of the materials required for our event as possible will be used many times in outreach events in the future- save the food of course and the U-Haul, which is rented. This will ensure that as many students as possible are reached with these funds and that enthusiasm for physics can be spread.

The total sum of these estimates with room for error is \$500.