



SOCIETY OF PHYSICS STUDENTS

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Texas Lutheran University SPS Marsh White Award Report 2014-15

Project Proposal Title	Outreach and Inreach - Building the TLU SPS Phenomenal Physics Outreach Program
Name of School	Texas Lutheran University
SPS Chapter Number	Chapter #7209
Project Lead (name then email address)	Stephen Bratz (2014-15 TLU SPS Chapter President)
Additional Project Leads (two lists: names then emails)	Jeffrey Breitschopf, TLU SPS Member
SPS Chapter Advisor	Dr. Toni Sauncy (tsauncy@tlu.edu)
Total Amount Received from SPS	\$300.00
Total Amount Expended from SPS	\$300.00

Summary of Award Activities

Our major goal with this award was to expand on the number and variety of demonstrations that our SPS Chapter had for use in various on-campus and off-campus events. The second goal was to increase the engagement of physics students and grow our TLU SPS Chapter. Finally, we aspired to develop a presenter's handbook since so many of our students were new to the idea of presenting cool physics demonstrations to a range of audiences. We have accomplished all of these goals. We built a new Ruben's tube demonstration, a new vacuum cannon demonstration, and presented outreach events both on and off campus for the first time in chapter history.

Statement of Activity

We carried out our Marsh White activities as follows:

- Organized TLU SPS students to research, design, and build two new pieces of demonstration apparatus. These were a Ruben's tube and a Vacuum Cannon.
- We presented our new demonstrations, along with others at two major events:
 - Seguin High School – An Afternoon of Physics (at Seguin High School with over 200 attendees)
 - Patlan Elementary School – Science Bonanza (On campus at TLU, in conjunction with our chemistry colleagues, with over 80 attendees)
- We have completed a first draft of a demonstration handbook for presenters

Overview of Award Activity

New demonstration apparatus – Ruben's Tube

One of our main goals was to design and build two different pieces of apparatus that would add to the list of demonstrations that TLU SPS could do.

- We set about finding the best design for a Ruben's tube, and decided on a version described in Figure 1, below.
- We then used bushings to connect the pipe to a small grill-sized propane tank. One improvement that we have planned for next year is to add an external regulator to the gas delivery system.
- The other end of the pipe was covered with small piece of a heavy duty helium balloon and secured with rubber bands.
- We then explored options for mating a speaker to the balloon covered end of the pipe. We finally designed a built a wooden stand that housed a speaker removed from a set of old computer speakers. A hole in the wooden mount was cut just larger than the diameter of the pipe so that it could slip over the balloon-covered end of the pipe. The wiring from the speaker was outfitted with an RCA plug for signal input.
- We then explored options for generating the tones for our Ruben's tube, and found an old function generator that provided enough voltage to generate an adequate amplitude.
- The last step is finishing our plex-glass safety shield. Many groups do not use any shielding when demonstrating the Ruben's tube, but we choose to err on the side of caution. In addition to preventing curious children from putting their hands in the propane flame, the shield curtails wind currents in the room and allows the flames to be seen better.

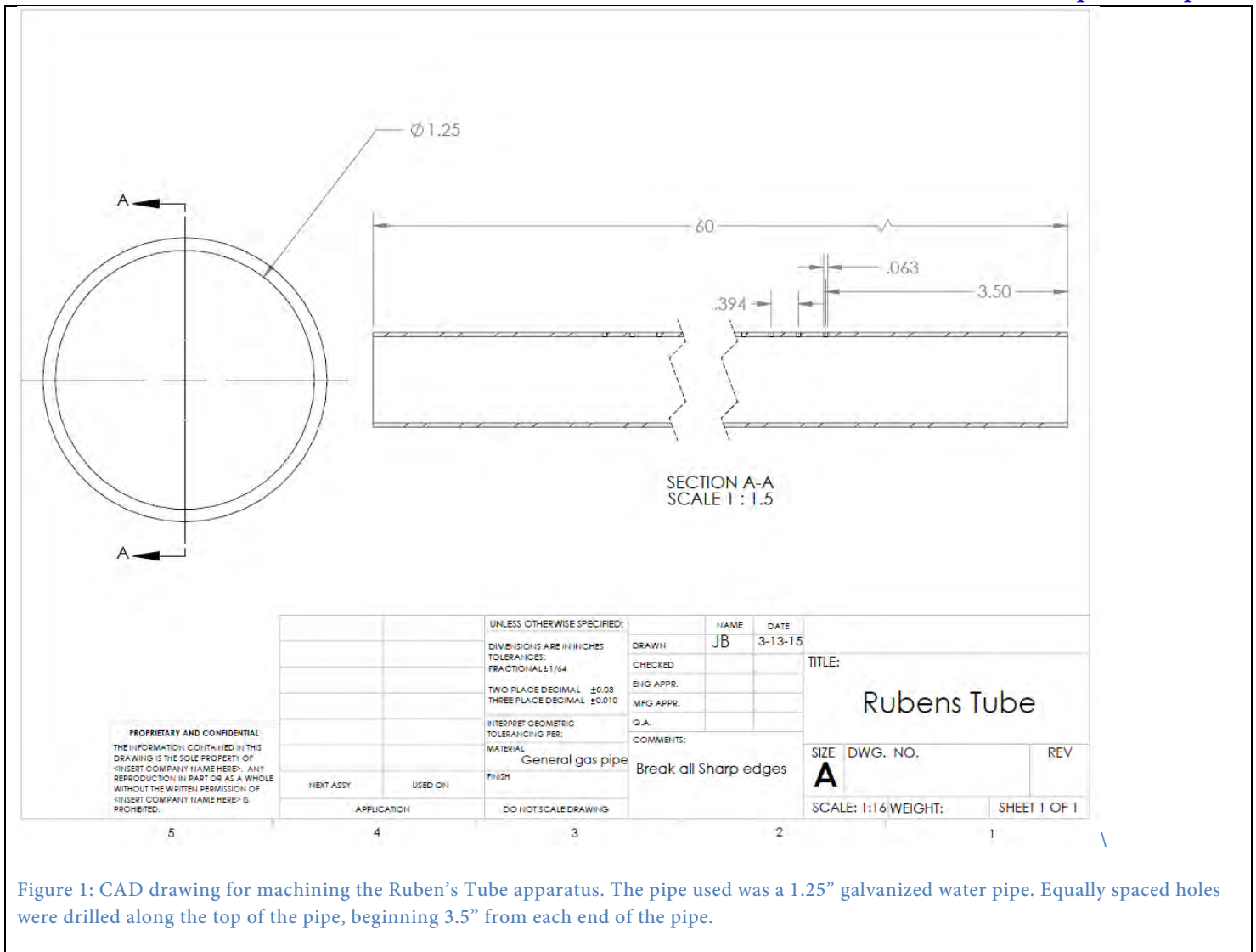


Figure 1: CAD drawing for machining the Ruben's Tube apparatus. The pipe used was a 1.25" galvanized water pipe. Equally spaced holes were drilled along the top of the pipe, beginning 3.5" from each end of the pipe.

New demonstration apparatus – The Vacuum Cannon

Our second new demonstration was a vacuum Cannon. We already had the necessary vacuum pump. We explored what other groups had done to make their vacuum cannon before proceeding.

- We cut a section of 1.25" PVC pipe to a length of 5 feet. The inner diameter of the pipe must be only slightly larger than the ping-pong ball projectile.
- We had to do several tries before we found the right size ping pong ball. It should just slip into the tube, with very little empty space around the ball.
- We then added a fitting so that we could connect the vacuum tube to the PVC pipe. This fitting was added using Teflon tape and secured with some silicone caulk. The fitting should be screwed into the PVC pipe so that it protrudes into the pipe by a small amount (~.13-.24") This fitting is placed near one end of the tube. It also serves the purpose of not allowing the ping-pong ball to slide all the way to the end of the tube.
- The ends of the tube were smoothed using progressively finer sand paper. The ends had to be smooth in order to properly seal (using mylar plastic, and a small amount of vacuum grease)

- Lastly, we used two 1.25” couplings to secure small pieces of Mylar on each end of the pipe. We used a “solar blanket” cut in to pieces for our Mylar. The ends of the pipe were coated with a very thin layer of vacuum grease and then the Mylar piece was pushed on with the pipe couplings. To form a taut membrane on each end of the tube.

Development of a Presenter’s Handbook

We have completed the first draft of the handbook with the help of Dr. Sauncy, our advisor. The book contains not only specific tips for presenting the demonstrations (the two new ones and others in our collection) but also tips for how to have presence in front of a variety of different audiences, as well as engaging K-12 students in more hands on activities presentations.

Major Outcomes

The most significant outcome of our receiving the Marsh White award was the boost of enthusiasm that the award gave the students in our physics department and our chapter and our effort to increase our outreach activity. We already have requests for outreach for next year! The SPS is in general more cohesive, with students having a common goal of doing cool and fun outreach.

Presentation Details

Seguin High School Physics Classes

Our group visited Seguin High School on Friday April 24. We were scheduled for three separate presentations, which meant that we would see every single student in a physics class in the school. This amounted to over 200 students, along with teachers and administrators. The SPS presenters shared lunch and a prep meeting, and then headed over for our very first off-campus demonstration presentation as a chapter!

We presented our demonstrations on a stage in an auditorium which was being used for a school play. Despite sharing the stage with a variety of unrelated props and costumes, the group persevered! We did the following demonstrations at each presentation:

- Static Pressure –crushing cans, water in a cup
- Vacuum Cannon
- Dynamic Pressure - Bernoulli Ball, ping-pong ball in a funnel
- Ruben’s Tube
- Grain elevator simulation (fire!)

These presentations were well received, despite the fact that the auditorium was not air-conditioned, and TLU SPS Students were on a black stage with very hot lights shining on them.

Patlan Elementary 4th and 5th graders

We joined with our chemistry colleagues for an on-campus demonstration show presented to 4th and 5th graders from a local elementary school. The chemistry student club, “Pi Rho” has a fairly active outreach record, but this was the first time that physics and chemistry had worked together to present an outreach event. The crowd

gathered in a large lecture hall and physics and chemistry took turns doing fun demonstrations for the group. SPS topped this event off by handing out diffraction grating glasses to the group.

Fund and dangerous anecdotal story to pass on to other groups – Warning – Vacuum Cannon Shrapnel!!

The last demonstration of the vacuum cannon presented us with a very dangerous realization about the energy made possible by the small pressure differential that makes the cannon work. The cannon was working extremely well, sending the ping-pong ball projectile through an empty aluminum soda can. On the last firing of the canon, the ball went through the can, and flew to the other side of a fairly large classroom. As we were hunting the ball, one of the participants exclaimed “Oh My!”, as she pointed to a small piece of shrapnel from the aluminum can that had been impaled into the ceiling tile above the head of one of the demonstrators. The small aluminum piece was approximately the size of a razor blade, with four edges approximately as sharp as a razor blade. This was a first for even the seasoned chapter advisor. We will now be purchasing materials to build a shield around the impact point to prevent serious injuries using the cannon in the future!

Impact Assessment: How the Project/Activity/Event Promoted Interest in Physics

Our goals were primarily to construct new apparatus and carry out one on campus and one off campus event, which we did.

Key Metrics and Reflection

Who was the target audience of your project?	TLU SPS Students (engagement), along with our local community of K-12 students. Specifically, Seguin High School Physics students.
How many attendees/participants were directly impacted by your project? Please describe them (for example “50 third grade students” or “25 families”).	~225 High School Physics Students ~25 High school teachers and administrators ~80 4 th and 5 th graders ~ 15 parents and teachers of said 4 th and 5 th graders
How many students from your SPS chapter were involved in the activity, and in what capacity?	We had in total (between construction and presenting) about 15 SPS students involved.
Was the amount of money you received from SPS sufficient to carry out the activities outlined in your proposal? Could you have used additional funding? If yes, how much would you have liked and how would the additional	We supplemented our Marsh White award with SPS funds and TLU department of Physics funds. For this particular project (the two new

<p>funding have augmented your activity?</p>	<p>demonstrations), the \$300 award was sufficient. If we had more money, we might have attempted building other apparatus for our collection.</p>
<p>Do you anticipate repeating this project/activity/event in the future, or having a follow-up project/activity/event? If yes, please describe.</p>	<p>We will use these new apparatus in our outreach both on- and off-campus, as well as in our classrooms for demonstrations. We already have requests for outreach activity next year, and will be expanding our annual Family Physics Night to include a full-blown demonstration show to supplement the hands on activities that we provide as part of that event.</p>
<p>What new relationships did you build through this project?</p>	<p>One really fun and important relationship is with the chemistry outreach team. This will be something that we will work to expand in coming years.</p>
<p>If you were to do your project again, what would you do differently?</p>	<p>One thing we counted on was the participation of a local machine shop, who backed out at the last minute. They had agreed to do some pro-bono work for us, but then for no apparent reason were not able to come through. This delayed our construction of the Ruben's tube, which we ended up drilling ourselves.</p>

Press Coverage (if applicable)

Our Marsh White award was featured on the TLU Web site in their news coverage. You can see the story here:

<http://www.tlu.edu/blog/tlu-society-of-physics-students-awarded-grant/>

and here:

<http://www.tlu.edu/campaigns/campaign1/february-9-student-week-a-glance/>

And, of course, we were thrilled to know that the awards are featured in the SPS Observer!

<http://www.spsobserver.org/2015/spring-stars.pdf>

Expenditures

Expenditure Table

Item	Cost
Materials and Supplies for Vacuum Cannon	\$75.00
Materials and Supplies for Ruben's Tube	\$160.00
Lunch for High School Outreach event presenters	
Diffraction grating glasses for outreach	\$80.00
Total of Expenses	\$315.00

(supplemented by SPS and TLU Physics)

Activity Photos



We are embarrassingly short on photos of our outreach. Shown in this photo are project coordinator, Stephen Bratz (right), and SPS member Josiah Navarro (left) demonstrating the new Ruben's tube.



A close up shot of a soda can that was destroyed by the ping pong ball projectile launched by the TLU SPS Vacuum cannon. This was the can that produced the dangerous shrapnel piece.



If you have any questions, please contact the SPS National Office Staff
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