



# SOCIETY OF PHYSICS STUDENTS

An organization of the American Institute of Physics

## ***Future Faces of Physics Award Application***

Project Proposal Title: Physics Apparatus Challenge: Materials And Numbers (PAC-MAN)

Name Of School: Cleveland State University

SPS Chapter Number: # 1247

Total Amount Requested: \$300

### ***Abstract:***

The Cleveland State University SPS chapter would use a Future Faces of Physics award to purchase supplies for a series of three “project-based learning” challenges for high school students at MC<sup>2</sup>STEM High School.

## Overview:

The Physics Apparatus Challenge: Materials And Numbers (PAC-MAN) program would invite high school students from MC<sup>2</sup>STEM high school to engage in a series of workshops involving the construction of the apparatus for physics experiments, and a challenge to devise an experiment or demonstration involving that apparatus.

High-school physics students complete the challenges while collaborating with volunteers from Cleveland State University's (CSU) Society of Physics Students chapter. The students then return their completed projects to MC<sup>2</sup>STEM school for future use; each is a durable piece of laboratory apparatus that can be used in future lessons and projects.

The four proposed sessions are:

- “Open House”: cool overview of CSU physics department with physics demos and tricks, introduction to SPS and upcoming challenges of PAC-MAN
- Challenge One: Make a Spectrometer
- Challenge Two: Build a Cosmic Ray Detector
- Challenge Three: Model a Meandering River

## How Proposed Activity Promotes Physics Across Cultures:

This project promotes physics across cultures by engaging students from a Cleveland public high school in physics projects in a university setting. It strengthens the relationship between Cleveland State University and the Cleveland Municipal School District begun with our elementary-school (CIS) outreach program, and provides MC<sup>2</sup>STEM high school with student-built apparatus for future physics education.

MC<sup>2</sup>STEM high school is a science-focused, public high school in the Cleveland Municipal School District. According to the Ohio Department of Education, 100% of its 289 students are reported “economically disadvantaged”, 78% are “black, non-Hispanic,” and 7.3% are Hispanic:

### 2012-2013 Report Card for MC<sup>2</sup>STEM High School



**Principal:** Jeffrey D. McClellan  
**Address:** 601 Erieside Ave  
 Cleveland OH 44114-1021

**Phone:** (216) 592-6875

*Directory information current as of the 2012-2013 Report Card publication date*

#### Your School's Students

**Average Daily Enrollment:**

289

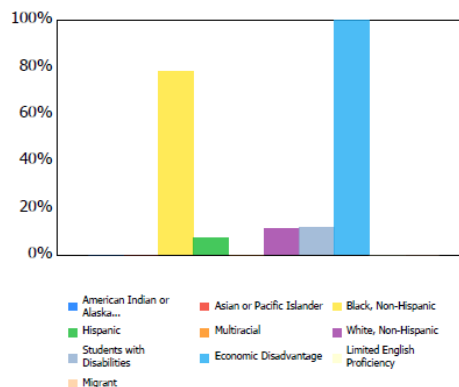
**Number of Limited English Proficiency Students Excluded from Accountability Calculations:**

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#### Enrollment by Subgroup

	Enrollment #	Enrollment %
Am. Indian / Alaskan Native	NC	
Asian or Pacific Islander	NC	
Black, Non-Hispanic	225	78.0%
Hispanic	21	7.3%
Multiracial	NC	
White, Non-Hispanic	34	11.7%
Students with Disabilities	35	12.1%
Economically Disadvantaged	289	100.0%
Limited English Proficiency	NC	
Migrant	NC	

NC = Not Calculated because there are fewer than 10 in the group



Source: Ohio Department of Education,

<http://reportcard.education.ohio.gov/Pages/School-Report.aspx?SchoolIRN=010200>

Beginning in the 2013 school year, the junior and senior classes of MC<sup>2</sup>STEM high school are hosted in a building on the Cleveland State University campus. This project would begin a collaboration between the MC<sup>2</sup>STEM high school and CSU's physics department which we hope will grow in years to come.

### ***Plan For Carrying Out Proposed Activity / Event:***

- **Personnel:** Outreach coordinator Chris Mentrek will oversee the project, coordinating efforts with three teams of SPS volunteers each dedicated to one of the PAC-MAN workshops. The SPS chapter faculty advisor, Dr. Kiril Streletzky, will organize the initial “open house” visit by the high school students and will supervise the preparations for the three projects that follow.
- **Marketing:** The outreach coordinator will work with the MC<sup>2</sup>STEM faculty to encourage high student participation in the project, and arrange exact scheduling of the workshops conducted at the high school. SPS faculty advisor and SPS officers will “reach out” to SPS members, physics and education majors in attempt to recruit volunteers for the project.
- **SPS Member Participation:** We estimate that 10 SPS members will serve as “construction supervisors” during the workshops, lead demonstrations during the “open house” event, and procure supplies for the workshops ahead of time. We also hope to recruit volunteers from other organizations at CSU (e.g., National Society of Black Engineers, Society of Women Engineers, etc.)
- **Expertise:** SPS volunteer Marie Blatnik will share her research experience in high-energy physics during the Cosmic Ray Detector workshop, and SPS/CSU physics alumna Krista Freeman will share her optics research experience during the Build A Spectrometer workshop. SPS president Phil Dee and SPS vice president Hannah Shuman will share their expertise in conducting Physics Day outreach events.

### **Session-by-session plan:**

- **Session One:** The “open-house” session will be modeled after yearly “Physics Day” open-house event conducted at the Physics Dept. Students walk from the MC<sup>2</sup>STEM building to CSU's physics department for a tour of its laboratories, and a brief series of demonstrations by SPS members detailing various physics concepts, their research, etc. During this session, the visiting students will also receive an overview of the three upcoming PAC-MAN workshops and meet the team of SPS volunteers.
- **Session Two:** In this workshop, students are challenged to construct a spectrometer. The workshop relies on the SpectralWorkbench software and Desktop Spectrometry Kit developed by Public Lab. The apparatus consists of a webcam, diffraction grating, instrument housing, and the software. (More information at: <http://spectralworkbench.org> ) Once the apparatus is completed, students test their device on a series of spectrum sources from CSU's equipment, and engage in a question-and-answer session with SPS alumna Krista Freeman on her experience with optics research as an undergraduate and graduate student. Afterwards, the students are challenged to devise an experimental question they could answer using their spectrometer in future lessons. (E.g., “Is our river polluted?” or “Can we determine the composition of a star?”)
- **Session Three:** In this workshop, students are challenged to construct a “Cosmic Ray Detector,” a Wilson-style cloud chamber for observing the tracks of high-energy particles in a super-saturated alcohol vapor. Once completed, the apparatus can be used to monitor different types of radiation, either from atmospheric “showers,” or laboratory sources. Students engage in a question-and-answer session with SPS volunteer Marie Blatnik about her research experiences with high-energy physics. Afterwards, students are challenged to devise an experimental question they could answer using their cloud chamber. (E.g., “Is my cell phone radioactive?” or “Is the number of sunspots related to the amount of radiation we detect?”)
- **Session Four:** In this workshop, students are challenged to create a physical model of a meandering stream using a “stream table,” and then to create a computer model that describes the stream's path. The “stream table” is, essentially, an inclined pan of fine sand through which water courses in a meandering path. Students then use the Processing computing environment to generate a computer model of the stream's course using a random-walker approach. Students engage in a question-and-answer session with SPS volunteer Chris Mentrek about his stream-monitoring work. Afterwards, students devise other experimental questions that could be answered using random-walker computer modeling.

### ***Activity Evaluation Plan:***

The PAC-MAN program will be evaluated by recording the number of participating students in each of the four sessions. In addition, post-workshop surveys for the students and their teachers will gauge students' impressions of and attitudes towards future study in physics; how have their impressions of the field of physics been changed by their participation in the workshops?

### ***Budget Justification:***

**Session One:** The open-house session makes use of existing SPS / physics department resources and equipment. No additional expenditure is needed.

**Session Two:** The spectrometer session funds allow for the assembly of four Public Laboratory Desktop Spectroscopy Kits. Allowing a class of 20-30 students to assemble and use four spectrometers keeps the participant groups at a reasonable size of 5-8. CSU's physics department will provide additional spectrum sources (such as gas tubes) to allow students to test their equipment.

**Session Three:** The cloud chamber session funds allow for the construction of four cloud chambers with an approximate volume of one cubic foot apiece. Again, having four copies of an apparatus allows for smaller group sizes during classroom use. CSU's physics department will provide additional materials (such as alpha-particle sources) to allow students to test their equipment.

**Session Four:** The stream-modelling session relies on the free, open-source Processing software, and has comparatively few expenses. The students construct a single "stream table" apparatus to model flow and erosive processes using low-cost materials (scrap lumber, plastic sheeting, sand) supplied by CSU. No additional expenditure is needed.

**Budget:****Spectroscope Session:**

<b>Item:</b>	<b>Number:</b>	<b>Cost:</b>
PublicLab spectrometer kit (includes webcam, diffraction grating, housing, and software)	4	\$40.00
<i>TOTAL:</i>		\$160.00

**Cloud Chamber Session:**

<b>Item:</b>	<b>Number:</b>	<b>Cost per item:</b>	<b>Cost</b>
Acrylic sheets (18" x 24")	4	\$5.00	\$20.00
Aluminum sheets (12" x 12")	4	\$5.00	\$20.00
Aluminum angle (3/4" x 48")	4	\$4.00	\$16.00
JB-Weld Epoxy	2 sets, 6 oz.	\$5.00	\$10.00
Silicone sealant	1 tube, 12 oz.	\$4.00	\$4.00
Rubber gasket (12" x 12")	4	\$10.00	\$40.00
Rubbing alcohol	24 oz.	\$2.00	\$2.00
Dry ice	5 lbs	\$7.00	\$7.00
Flashlights, focusing	4	\$5.00	\$20.00
<i>TOTAL:</i>			\$139.00

**Total award request: \$300**