The Cleveland State University (CSU) physics students will use the award to continue our outreach program with a local public school. This year our program will explore the way school-aged kids encounter physics every day: from refrigeration of milk at breakfast to switching off reading lights at night.
Physics Outreach at Campus International School

Organized and presented by the students, faculty and staff of the Department of Physics at Cleveland State University

Funded by the Marsh White Award from the National Society of Physics Students
After School Physics Club

- **Who?** Members of the Cleveland State University chapter of the Society of Physics Students and after-school students at Campus International School, a public school in Cleveland, OH

- **What?** Fun and interactive activities with a different physics theme each month

- **Where?** Campus International School, a local public school following the International Baccalaureate Primary Years Programme

- **When?** After school once every month (since January 2011) during the academic year

- **Why?** To get young students excited about science and higher education by nurturing relationships through learning
2013–2014 Physics Themes

- Radiant Rainbows
- Dry Ice Investigators
- Making Simple Machines Work for Us!
- Is Your Refrigerator Running? Let’s Learn How!
- Can You Hear Me Now? Exploring Sound Waves
- 3…2…1…BLAST OFF! A Rocket Adventure
Radiant Rainbows

- We experimented with many ways to make and view rainbows both indoors and out!
- Through experiments, we learned that the ingredients for an outdoor rainbow = Sunlight + Water droplets in the air + Eyeballs + The right place to stand
- We learned that white light is made of all the colors of the rainbow
- Each student made a paper spectroscope and used it to break white light into its colors
Dry Ice Investigators

- What IS dry ice? How cold is it? Why does it take so long to melt? What makes it smoke? How can we melt it?
- We answered these questions by:
  - Measuring the temperatures of dry and wet ice
  - Comparing the weight of dry ice “smoke” to air
  - Using dry ice “smoke” to blow up balloons
  - Performing a chemistry experiment that proves dry ice smoke is actually carbon dioxide!
Dry Ice Investigators!
We explored several simple machines and discovered how they could help make our lives more...well, simple!

We balanced forces with a force table—we learned about equal and opposite forces too.

We explored how an Atwood Machine and a system of pulleys works.

Need a third arm? We’ve got you covered!

Even the smallest of us could lift a heavy bucket of sand using a clever pulley design!
Simple Machines!
Have you ever wondered how your fridge works? Here, we took a look inside everyone’s favorite home appliance and found physics!

- We learned how cooling coils in a fridge rely on the relationship between temperature and pressure.
- Different materials have different temperatures—we felt how cool rubbing alcohol feels on our skin compared to water or air!
- We explored different ways to keep ice frozen longer. Hot metal melts ice quickly while Styrofoam keeps it frozen longer.
- Phase transitions explain why ice melts into water and water turns into steam—we observed phase transitions with the help of liquid nitrogen!
We explored the physics of sound—our favorite noisy day!

We learned that sound is a longitudinal (or squishy) wave that has a vibration as its source:
  ◦ We made homemade straw oboes—when you blow into the cut end you create vibrations, which create a really funny noise.

Like all waves, sound has direction. It travels until it bounces off of (or is absorbed by) an object in its path:
  ◦ Some objects reflect sound well, and some absorb it. We experimented with sound waves traveling through, bouncing off of, or being absorbed by many different materials.

Sound waves have nodes and antinodes—more nodes means a higher pitch! We explored this concept by playing great music with a set of tubes of different lengths.

We learned how resonance depends on pitch with a wave generator and different hollow objects, like a drum.
This end-of-the-year lesson sent us all rocketing into space on homemade rockets!

We learned the word thrust, and realized that rockets rely on thrust to power them into space:

- We used balloons to explore thrust—when the air moves one way, the balloon moves the opposite way. We used this concept to send a balloon powered rocket ship on a mission!

We learned about rocket stability and how important it is for space exploration:

- We can improve the stability of a balloon rocket by controlling the thrust—adding a straw to the end directs the thrust so the balloon rocket moves in a straight line.

We built our own paper rockets and launched them from a launch pad. We learned that our rockets couldn’t have any air leaks, or they wouldn’t fly! The rockets also needed fins and some added weight in the nose for stability.
3...2...1... 

BLAST OFF!
2013-2014 Participants

- Dr. Kiril Streletzky
- Krista Freeman (Outreach Coordinator)
- Chris Mentrek
- Jim Pitchford
- Marie Blatnik
- Richard Kolk
- Liz Brochu
- Janna Mino
- Grace Gaeckle
- Tara Peppard
### Key Metrics and Reflection

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Who was the target audience of your project?</td>
<td><strong>Elementary school kids</strong></td>
</tr>
<tr>
<td>How many attendees/participants were directly impacted by your project?</td>
<td>50 afterschool program K-5 kids at Campus International School (CIS)</td>
</tr>
<tr>
<td>Please describe them (for example “50 third grade students” or “25 families”).</td>
<td></td>
</tr>
<tr>
<td>How many students from your SPS chapter were involved in the activity, and in what capacity?</td>
<td>6</td>
</tr>
<tr>
<td>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 funding have augmented your activity?</td>
<td>The money paid for the bulk of expenses. However, Physics Dept “in kind” contributions were critical especially for the second (Fall) semester of outreach. Without “in kind” support another $300-500 would be needed.</td>
</tr>
<tr>
<td>Do you anticipate repeating this project/activity/event in the future, or having a follow-up project/activity/event? If yes, please describe.</td>
<td>Yes. The outreach program has been successful for the last 4 years and should be continued.</td>
</tr>
<tr>
<td>What new relationships did you build through this project?</td>
<td>The great relationship with CIS and its kids who remember SPS outreach team and wait for its return from semester to semester.</td>
</tr>
<tr>
<td>If you were to do your project again, what would you do differently?</td>
<td>Involving more of current CSU students; better separation of activities between younger (K-3) &amp; older kids (4-6 grades)</td>
</tr>
</tbody>
</table>

### Press Coverage (if applicable)

http://www.csuohio.edu/news/csu-students-engage-campus-international
### Expenditures

#### Expenditure Table

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building materials for simple machines (wood, pulleys, rope, bolts and washers, etc)</td>
<td>52.97</td>
</tr>
<tr>
<td>Dry Ice supplies, compressed air cans, gift thermometers, bike-pumps</td>
<td>125.00</td>
</tr>
<tr>
<td>DVDs, skotch tape, scissors, jello, pump misters, construction paper</td>
<td>75.00</td>
</tr>
<tr>
<td>Air Pump, construction paper, balloons, rope</td>
<td>44.32</td>
</tr>
</tbody>
</table>

**Total of Expenses** 297.29