# The PolluCell

## Generating Electricity Using Waste and Pollution

by Sahil Doshi

Even before my sister told me about the Discovery Education 3M Young Scientist Challenge (YSC), I was thinking of a way to solve two big problems: the lack of access to electricity in developing countries, and the excess of carbon dioxide in the atmosphere. As I thought about ways to address these two problems, I came up with the idea of a battery that uses carbon dioxide and recycled materials to generate electricity. Learning about the YSC was exactly the motivation I needed to pursue this idea. The contest is for students in grades five through eight; as an eighth grader, I was in my last year of eligibility. There was no time to waste.

To enter the challenge, I had to submit a one- to two-minute video about my idea for an innovative solution to an everyday problem. My battery idea definitely fit the bill, but I had a lot of work to do before I could make a video about it.

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### Battery Basics

A battery consists of one or more electrochemical cells, each of which contains two half-cells: an anode and a cathode. The anode is more prone to losing electrons, while the cathode is more prone to gaining electrons. When you attach a wire between the anode and cathode, electrons flow from the anode to the cathode through the wire, creating electricity. An external device, such as a lightbulb, can be powered by attaching it to the wire.

I wanted my battery to use inexpensive and preferably recycled materials. For the anode I chose aluminum, which easily loses electrons and which, in the form of used beverage cans, is readily available. I knew that silver would make an effective cathode, but people don't usually discard it. Fortunately, I found a good source in my used silver-plated copper guitar strings.

I put carbonated water in the two half-cells and added salt to each to catalyze the reaction, then placed aluminum in one and guitar strings in the other. To speed up the reaction, I attached two copper wires to the terminals of a 9-volt battery and put the end of each wire into the water. I eventually created a cell that converted the carbon dioxide in the water into approximately 800 millivolts of electricity.

I spent over a month developing prototypes before I began filming. Creating the video itself was very difficult because all of the project's information had to be reduced to just one to two minutes. I spent hours editing and re-filming before finally submitting my entry the day before the deadline.

### Improving on Success

When I entered the competition, I didn't think I had a chance of winning, as this was my first time entering. When I got a call in June saying that I was selected as one of the ten national finalists, I was exuberant.

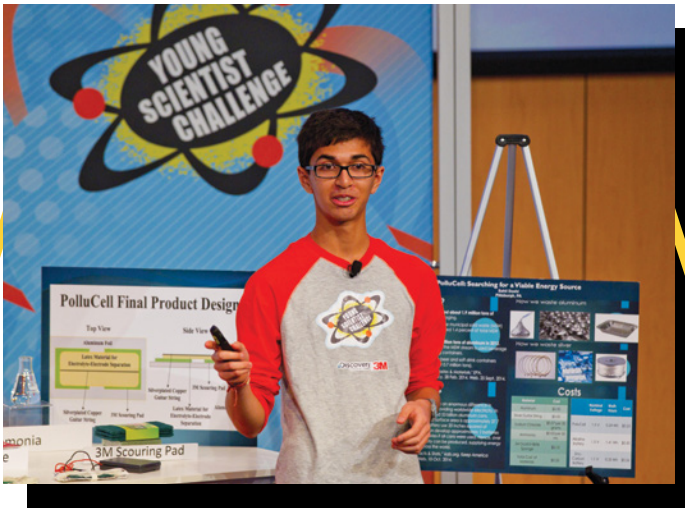
Each finalist was paired with a 3M scientist, who would serve as their mentor. In July, I met my mentor, Dr. Jim Jonza, a polymer chemist at the 3M World Headquarters in Minnesota, via a phone call. After discussing how the project would look at the final event, we set weekly goals leading to the competition finals in October. Every week, Dr. Jonza and I talked over the phone about improvements I'd made on the project. On Google Drive, we looked at photos highlighting my progress as well as documents illustrating ideas for improvement.

This routine continued for three months, until I developed and tested a prototype that I would use in my five-minute presentation at the competition.

### In the Spotlight

On October 12, I boarded the plane from Pittsburgh to St. Paul, Minnesota, readying myself for three days of nervous excitement. On the first night, the finalists got to know each other and meet the judges and staff at an ice cream social. The event was a huge stress reliever, as I saw that the other finalists shared many of my interests, from science to sports to video games.


At the national competition, Sahil and his partner work to devise a Rube Goldberg machine using common household items.




On the last day of competition, Sahil presents his invention before taking audience questions.

The next day, after a tour of 3M World Headquarters, it was time to get down to business. In teams of two, we were assigned a problem to solve using 3M products. My partner and I had to develop a compression wrap system for a dog that would provide flexibility for a joint and not pull the dog's fur. We had to develop our solution and create a poster presentation about it—in just two hours. Afterward, exhausted and unaware of how we did during the challenge, all the finalists relaxed and bonded over Wii and ping-pong.

The second day of the competition was the most grueling. In the morning, we departed to the 3M Innovation Center to begin the second phase of the competition, the Rube Goldberg Contest. In this task, we each worked with a new partner to devise and build a machine that would trigger multiple energy conversions and chemical reactions to ultimately activate a mouse trap. Given only common items such as toys, tape, and other household products, we again worked against a two-hour deadline. When we ran our machine for the judges, it did not successfully trigger the chemical reaction but did activate the mouse trap. Although our machine did not fulfill every requirement, our ability to explain each component seemed to impress the judges.

Afterward, we began preparing for our final presentations. Tables were covered with prototypes ranging from small to massive, and boards were displayed for visual aid. One finalist had a small LEGO MINDSTORMS robot that prevented hydroplaning, while another had a big device that filtered out air pollutants. Everyone could be heard silently reciting their presentations as the clock counted down to the first presentation. Then, one by one, each finalist presented their innovation on stage for five minutes and then had five minutes for questions and answers. When my turn came, I confidently began my presentation but didn't finish it before my five minutes was up. Fortunately, I was able to compensate for the lost material during the question-and-answer session.

After the presentations, we headed back to the hotel to prepare for the awards banquet where the winner would be announced. At this point, we were all in a good mood because regardless of the results, we had made it through the most difficult phases of the three-day trip. At the ceremony, we heard speeches from 3M and Discovery Education representatives before the announcements were made. As each of the three runner-up positions was filled by another finalist, I could feel my heart racing. The suspense collapsed when the announcer named me as the winner of the Discovery Education 3M Young Scientist Challenge! I walked on stage, beaming, and accepted the trophy and a check for $25,000. I could not have felt more grateful to my sister for telling me about this wonderful contest.

The Discovery Education 3M Young Scientist Challenge has opened the door to many other opportunities. I have spoken at a STEM gathering in Miami and another at my school, appeared on Fox News, and have even presented my project to President Obama at the White House Science Fair. I have also continued to build on what I learned, and I'm now working on constructing an integrated system of carbon dioxide capture for energy generation. The Young Scientist Challenge gave me so much more than great memories. It showed me that I can help create the future. ■

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**Learn more about the Discovery Education 3M Young Scientist Challenge at www.youngscientistchallenge.com.**