I’ve had migraines for as long as I can remember. In addition to being incredibly painful, these headaches—which last from two hours to three days—cause nausea, vomiting and increased sensory sensitivity. Whenever I had a migraine, I would take medication, wait for it to kick in, and eventually fall asleep to wash away the pain. For years, migraines remained a constant source of interruption in my daily life.

Then, when I was in fifth grade, my doctor suggested I try acupuncture.

By this time, my migraines only subsided with sleep. Most medications I tried had proven ineffective; some restricted my activity more than the headaches themselves. Acupuncture was different. Not only did it provide relief when I got migraines, but it reduced their frequency.

Idea to Reality
During acupuncture, thin, flexible needles are inserted into specific points on the body, depending on treatment goals. This stimulation of points rich in nerve fibers triggers the release of neurotransmitters and cortisol, which can reduce pain and inflammation.

While acupuncture relieved my migraines, it has its downsides. Treatments last 30 minutes to an hour, and, repeated up to three times a week, are time consuming. Treatment can also be expensive, and many find the needles intimidating. Most importantly, acupuncture may not be readily available when pain strikes. After each session, I found myself wondering if there was a way to create something as effective as acupuncture but more convenient and less expensive.

When I learned about the Discovery Education 3M Young Scientist Challenge (YSC) in science class, I saw an opportunity to explore my idea. The YSC provides students in grades five through eight with a platform on which to build their skills of communication, observation, and collaboration, and encourages them to pursue ideas in science. To enter, applicants create a video detailing an innovation that addresses an everyday problem.

In my video, I described a machine that would achieve the same results as acupuncture by sending electrical currents to acupuncture points in the body. My Acupoint Stimulator (APS) would be controlled by a smartphone and fit in a pocket for instant use. I was eager to put my idea into action,
were in the control or treatment group. This ensured that reduced pain levels in acupuncture points. Patients rated their level of pain before and after treatment.

Ten patients with lower back pain and ten with chronic headaches were recruited. Each group was then divided into treatment and control groups. Treatment group patients received the stimulation to non-acupuncture points. Control group patients received the stimulation to non-acupuncture points. Patients rated their level of pain before and after treatment.

The results were significant. Pain was reduced by 56 percent in the back pain treatment group, and by 66 percent in the headache treatment group. Meanwhile, neither control group showed significant changes in pain levels, suggesting that the Acupoint Stimulator was able to relieve chronic pain.

**Acupuncture To Go**
Each finalist is assigned a scientific mentor from 3M to guide them through the innovation process. I collaborated by phone with Dr. Cordell Hardy, a technical manager in 3M’s Safety, Security and Protection Services Laboratory. Throughout the summer, we discussed the scientific processes, problems, and progress of my project.

Since I planned to control the APS with a smartphone, I needed to determine how to send a signal from a smartphone to the APS to initiate the electrical stimulation. I’d wanted to use an app, but as an inexperienced programmer, I hadn’t anticipated how much work writing an app entailed. I knew I wouldn’t be able to finish the app by the deadline. Then, as I was assessing the degree of electrical stimulation the APS needed to be effective, I discovered that its electrical signal frequency was on the same frequency spectrum as music. I could create an electrical signal file that could be downloaded and then played, through Bluetooth, as a signal for the APS!

Now I had to create the APS itself. With help from Dr. Hardy and my dad, I sketched a circuit design of the APS and incorporated all the components. Next, I had to find a battery that was the right size and voltage for my device. Eventually, I chose a 3M lithium ion battery (every finalist needed to incorporate a 3M product into their design). Then I created a prototype of the Acupoint Stimulator.

**Testing, Testing**
To test my device, I recorded the acupuncture stimulation signal frequency from an electrical stimulator at my acupuncturist’s office, converted it to an electrical signal file on my computer, and downloaded the file to my smartphone. Next, I “played” the signal from iTunes to the Bluetooth receiver on the Acupoint Stimulator. When the signal was too weak to start the stimulation, I created an amplifier on the APS that could receive the signal from the Bluetooth receiver, amplify it, and send it to the electrodes (also 3M’s), which would then begin stimulation of the acupuncture point. I was thrilled when my device worked!

Still, I needed to test its effectiveness on pain. I proposed a pilot study protocol to my acupuncturist, who agreed to conduct trial studies using the APS. Ten patients with lower back pain and ten with chronic headaches were recruited. Each group was then divided into treatment and control groups. Treatment group patients received 30 minutes of APS stimulation to acupuncture points in the lower back and/or temples. Control group patients received the stimulation to non-acupuncture points. Patients rated their level of pain before and after treatment.

This was a single blind study, meaning patients didn’t know whether they were in the control or treatment group. This ensured that reduced pain levels in the treatment group relative to the control group would be a result of the APS, not the so-called placebo effect.

While I didn’t win a top prize, participating in the YSC was an incredible experience. I worked with great people, met new friends, and was able to make my idea a reality. I’m planning to develop a rechargeable battery for the Acupoint Stimulator and study the long-term effectiveness of the device. I’m also considering a career in biomedical engineering, where I can continue to create innovative medical devices and solutions for the future.

Brandon Gong is in eighth grade at Garden City Middle School in New York. He is a member of the Science Olympiad, science club, and math club. Brandon loves science and also enjoys playing clarinet, piano, and oboe.