Name: _____ Date: _____

# How Did Gitanjali Rao Invent a Lead Detector?

Reading level 10 (6th grade) · 1224 words

How did Gitanjali Rao invent a lead detector? She did it in steps. In October 2017, at age 11, she won the Discovery Education 3M Young Scientist Challenge and $25,000 for Tethys. It was a tool made to find lead in water. Years later she named the five steps she uses on every project: observe, brainstorm, research, build, and communicate. Her steps came later, so this book lays the Tethys story against them, one at a time. It also shows how tiny tubes of carbon can tell you what is in a glass of water.

Step one is to observe. Rao said she had followed the water issue in Flint, Michigan, for about two years. "I was appalled by the number of people affected by lead contamination in water," she said. Lead can get into drinking water when pipes that contain it wear away. The EPA lists lead pipes, faucets, and fixtures as the most common sources. It sets its health goal for lead in drinking water at zero. The CDC says no safe blood lead level in children has been found.

Step two is to brainstorm. Ask what already exists and where it falls short. The EPA says testing is the only sure way to learn if water has harmful lead. It points families to approved labs. Another choice is a test strip. One 2017 report said strips are fast but not always accurate. Rao said of the way people could test at home, "this is not a reliable process and I've got to do something to change this." She wanted a tool that was more exact. She also wanted it to be easy to use at home, with quick results.

Step three is research. Her tool would use nanotubes. A nanotube is a tube made only of carbon. The thinnest ones are about 0.5 to 2 nanometers wide. That is tens of thousands of times thinner than a hair. One reference says they react to changes in their chemical surroundings. The change shows up as more or less electric current. Factories already use them in sensors that pick up gases and smells. These are called electronic noses.

An idea needs a place to be tested. Rao's was the Young Scientist Challenge, which is open to kids in grades 5 through 8. Each entrant sends in a video, one to two minutes long. It tells about a new invention or a fix for an everyday problem. Today, entries must be by one person, and the judges do not score how polished the video is, so even a phone recording is fine. In 2017 the videos were due by April 19. Ten finalists were then picked. Rao was one of them.

The ten finalists spent the next three months with scientists from 3M, the company that backs the challenge. Each one builds a prototype over the summer. A prototype is a first working model of an idea. Rao was matched with Kathleen Shafer, a research specialist who develops new plastics technologies. Under today's rules, the last event is a set of talks and scored challenges. Each finalist presents the summer's work. Each also takes part in challenges that

test science knowledge.

Step four is build. Tethys has three parts. The first is a cartridge that is used once. It holds rows of nanotubes that were treated with chemicals. The second is a signal processor built on Arduino technology, with a Bluetooth link. The third is a smartphone app that shows the result. One report called it portable and fairly cheap. Rao said it could one day be widened. Then it could test for other chemicals in drinking water.

As the 2017 reports tell it, the tubes are sensitive to changes in the flow of electrons. They are lined with atoms that have an affinity for lead. That adds a measurable resistance to the flow. In clean water the flow stays the same, so the app says it is safe. In water with lead, the lead reacts to those atoms. Resistance goes up, the Arduino processor measures it, and the app says the water is not safe. That is the 2017 description. A bare nanotube reacts to many things. So such a sensor depends on a coating that picks out lead.

Building it was not smooth. "I had so many failures when I was doing my tests," Rao said. Then she added, "I knew all these failures, which were learning experiences, would make my experiment better." That is the heart of the build step. A test that fails still gives you data. By this book's reading, it can show which part to change: the cartridge, the signal, or the way you read the result.

In October 2017, Rao was named the grand prize winner and got $25,000. One of the judges said, "It's not hyperbole to say she really blew us out of the water." She said she would save some of the prize and use the rest to put into her tool, to make it commercially viable. That means able to be sold. Reports from that time call Tethys a prototype. They say it was meant to find lead faster than other ways then on the market.

How would you know a new sensor works? By this book's reading, you test it against a trusted method on the same water, many times. In January 2019, NPR said Rao was working with a Denver Water lab manager. She was checking whether other chemicals, such as fluoride, could disturb the reading. The EPA says testing is the only sure way to learn what is in your water. If you worry about lead at home, the EPA suggests asking your water utility and using a certified lab. It also suggests running the tap first. Boiling does not remove lead.

Step five is communicate. In December 2020, TIME named Rao its first Kid of the Year. She was picked from more than 5,000 nominees. TIME is a news magazine, and its Kid of the Year list had five finalists, ages 8 to 16. By then she ran workshops for other kids. She said they began as a simple talk and lesson plans. Later they grew to include labs and contests. She also said she had hit her goal of 30,000 students mentored.

The same steps work on other problems. Rao made Kindly, a tool that uses artificial intelligence to spot cyberbullying early. She said she first typed in some words that could be bullying. She also asked parents, teachers, and students in a survey. She said its goal is not to punish. UNICEF describes Kindly as an open-source tool that uses machine learning to

spot cyberbullying intent in text, so a child can rethink a message first. In July 2025, MIT News described it as a UNICEF Digital Public Good service.

Rao's workshops squeeze the whole cycle of steps into a short time, so people can try it for themselves. "If you can do this in 45 minutes to an hour, imagine what you can do if you spend months and months working on it," she said. Her advice is to find one thing you care about and solve it, and not to feel pressured to come up with something big. "At the end of every workshop," she said, "everyone has something that they can start working on."

## Questions

**1. What are the five steps Rao says she uses on every project?**

A. Copy, paste, build, sell, share
B. Observe, brainstorm, research, build, communicate
C. Read, write, test, win, rest

**2. Why did Rao look for something other than a test strip?**

A. One report said strips are not always accurate
B. Strips cost too much money
C. Strips were against the rules

**3. According to the 2017 reports, what happens inside the cartridge when lead is in the water?**

A. The flow of electrons speeds up
B. The cartridge stops working
C. Resistance rises and the processor measures it

**4. In the sentence "They are lined with atoms that have an affinity for lead," what does affinity mean?**

A. A fear of
B. A natural pull toward
C. A color of

**5. Why does this book say a new sensor should be compared with a trusted method?**

A. To learn whether its readings can be trusted
B. To make the sensor smaller
C. To win a prize

## Words to know

nanotubes: tiny carbon tubes
prototype: first model
resistance: slows electric flow
affinity: natural pull

commercially: to be sold

# Answer key: How Did Gitanjali Rao Invent a Lead Detector?

1. B. Observe, brainstorm, research, build, communicate
2. A. One report said strips are not always accurate
3. C. Resistance rises and the processor measures it
4. B. A natural pull toward
5. A. To learn whether its readings can be trusted