

Nature of Science & Math: Analyzing the Presence in Everyday Communication

Amber Miller

Course: Methods of STEM Education - Secondary

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I started this assignment by going to google.com and researching, “new information in science”. I wanted to find something relevant, new, and interesting in the field of science to research. My students are very intrigued by technology and human health. I frequently hear them talking about robotics and what it could mean for the future of the human race. With so many superhero movies coming out with heroes having robotic arms or completely robotic humans (cyborgs), I thought this would be a great topic for them as well. I found an article that matched everything I was looking for. A new 3-D printer that builds temporary electronics on human skin! Here is the site:

<https://www.sciencenews.org/article/new-3d-printer-builds-temporary-electronics-on-your-skin?tg=nr>

I found the initial information on sciencenews and was blown away, so I research more (not believing the first article I read) and found multiple trustworthy sites talking about the same thing. In this assignment I will be discussing both the initial article I read by sciencenews and the follow up article, healthline. Obviously, I was interested in the technological background of the new device, but as a science teacher with a bachelor degree in biology I was curious about the health factors. I want to begin with the background of the 3D printer, how it was created, and what we could use it for. I then want to discuss the biological standpoint for the person with the skin it will be on. Finally, I will compare this article to the tenets of the Nature of Science relevant to NGSS. This will answer the question; is this article fit for my classroom and does it follow the STEM program?

The 3-D printer that is able to print on human skin was brought into existence by scientists from many different laboratories working together. These research facilities were: the

Universidad Carlos III de Madrid, Spain's Center for Energy, Environmental and Technological Research, and Hospital General Universitario Gregorio Marañón center. In January 2017 they published their prototype in the journal *Advanced Materials*. The printer works by sticking a LED light to the person's skin, then having the printer create a circuit around the bulb.

According to Maria Temming from *livescience* its polymer ink laced with silver flakes. Silver is the best conductor of electricity on the periodic table of elements. The hope is to also create 3-D batteries that will power the device. The device itself can stay on for 2 hours or it can be removed by peeling it away (Temming, 2018). This is a great device, but how does it help human endeavors?

The 3-D printed device has so many possibilities its creators are still coming up with ways it can be used! "Soldiers may be able to use the technology to detect chemical weapon threats. You might be able to use it to recharge electronic devices" (Curley, 2018). Imagine having a device on your very skin that can charge your phone! We could use less electricity or even have the device be solar powered. This could cause people to spend more time outside enjoying their environment. Soldiers being able to use this device in the field to help them detect harmful chemicals before entering a building is incredible. In the *Healthline* article I read they interviewed Terry Wohlers, president of Wohlers Associates Inc. He is a consultant with a firm in Colorado that provides technical and strategic consulting on 3-D printing. He said "I could foresee the printing of sensors on animals for the beef industry or onto pets for tracking purposes". Our society can not only use this device, but draw ideas from it to improve life. Just last month at the University of Toronto a working 3-D printer was released for skin grafts (Curley, 2018). We are already designing prosthetics and organs using 3-D printing. I think it is

extremely beneficial for students to be learning about this device in the classrooms; it seems like 3-D printing is the future.

I would use this article in the classroom and have students research the device for themselves. I would also create a lesson in which students think of ways in which this technology could be used. To make sure it fits in with a STEM lesson I am going to make sure it hits 3 out of the 8 tenets of Nature of Science discussed in NGSS. I will also make sure 3 of the Common Core Math practices are met. Each one of these will be broken down into subheadings.

Part A.

Scientific Knowledge is Based on Empirical Evidence

According to Wikipedia, empirical evidence is sensory experiences. Which means the information is received by means of the senses through observations and documentation. The first way they went about testing the 3-D printing was to create the right substance for the silver substance to go on human skin. This had to be done using sense, touch. This design was a trial and error, it has been in the works for years. The many research teams used observations and recorded data until the light was able to turn on, literally!

Scientific Knowledge Assumes an Order and Consistency in Natural Systems

A Natural System is one in which physical and biological materials are combined to complete a process. This would be the human tissue (squamous, cuboidal, and columnar aka human skin) combined with the electrical current running through the silver current to power the LED light. The circuit is consistent for the amount of time available at the moment. The order in

which this occurs is the negative electrons flowing through the circuit to produce the current that sends electrical power to the LED light. The 3-D printer has been modified to work with the natural human responses, such as fidgeting. If the person fidgets or begins to sweat while the device is being applied it adjusts in real time!

Science is a Human Endeavor

The research teams worked for years on 3-D printing in order to benefit humankind. 3-D printers were first created for technological purposes and building things. They got so good that you could use a 3-D printer to build another printer! As with everything society which its gaze to human health. 3-D printers are used to create organs, graft tissue, and even prosthetics. This new thinking into electricity on human skin could mean even more advances in human health and longevity in the future. The possibilities in themselves seem endless.

Part B.

Make Sense of Problems and Persevere in Solving Them

How could a printer create an electrical circuit and place it on a portable device? The problem faced by the research teams for the 3-D printer was the availability of electricity without electricity. They came up with a way to create a circuit without an outside source using human skin to attach it and generate electrical pulses. A portable way to generate electricity in the battlefield as a soldier or just out on a walk in the woods for a citizen. The team was already working with these printers and began conducting experiments to see how it could create silver

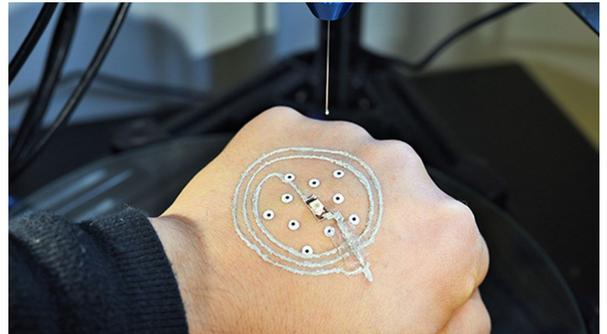
flakes laced in the ink for the printer. The team kept with it in recording data and published their work when complete.

Attend to precision

Humans are flawed and we make mistakes. Having something as important as a silver laced ink placed strategically onto your hand to be used to generate an electrical current to power a light is stressful to say the least. Maybe the person begins to sweat or shake. The entire experiment would be destroyed! The research teams out of Universidad Carlos III de Madrid, Spain's Center for Energy, Environmental and Technological Research, and Hospital General Universitario Gregorio Marañón center thought of this. Their 3-D printer has a certain path to follow on the person hand to complete the circuit and will pause and correct if something goes wrong. The device was designed to be precise even correcting for human error.

Look for and make use of structure

The image below is courtesy of McAlpine group out of the University of Minnesota. The image shows the structure of the circuit as it is drawn on the back of a human hand. The structure must be precise to finish the



circuit and cause the LED light to glow. The research teams first had to create the right ink to generate the electricity they then had to form the right circuit. The circuit in itself must be a single circuit, so it can easily be removed and the power lost when necessary. They had to first find the right structure then make use of it in their design.

Resources:

Curley, Bob (2018, June 4). *What 3D Printing on Your Skin Could Be Used For*. Retrieved from <https://www.healthline.com/health-news/what-3-D-printing-on-skin-could-be-used-for>

Temming, Maria (2018, June 6). *A new 3-D printer builds temporary electronics on your skin*.

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