Abstract Section

Many people from around the world suffer from mosquito-borne illnesses such as West Nile virus, yellow fever, dengue, and malaria. It's estimated that 300-600 million people die from malaria each year. More that 40% of the population lives in "malaria-risk" areas.

Our technology will keep mosquitos from biting humans to help stop these diseases from spreading. We will insert graphene nanotechnology into a lotion. This nanotechnology will block mosquitoes from biting us. This lotion will be safer than a traditional chemical bug spray, and it will also be more effective than mosquito-blocking clothing.

Present Technology

Nanotechnology is a type of science that is based on building molecules the atomic level. Everything is made of atoms. The chair you're sitting in, the floor you're standing on, all made of atoms. But humans cannot see them because they are so small. Atoms are measured by nanometers. Nanometers are one billionth of a meter. Certain atoms put together can make other atoms. Atoms put together can make molecules. Molecules can make objects. Nanotechnology is the process used to make graphene, which is a vital material for our invention.

Graphene is a one-atom thick layer of carbon atoms. It's made of a sheet with carbon atoms bonded together in a honeycomb formation. Graphene is completely impervious. Even the smallest atom (helium) can't get through it. Graphene is incredibly strong, very light, and extremely flexible. It conducts electricity and heat better than almost any other material, and it is used for multiple new inventions, such as creating better tennis racket strings.

Graphene is the main ingredient in the material graphite, which we use in our pencils. It is made when a carbon atom connects with 3 other carbon atoms. Graphene is also widely used because of the strength in the covalent bonds between the atoms. A covalent bond is a type of atomic bond where atoms share electrons. Clothing companies like Vollebak use graphene because of how strong it is. Each sheet of graphene is considered one molecule and instead of a nano tubular shape, graphene is flat.

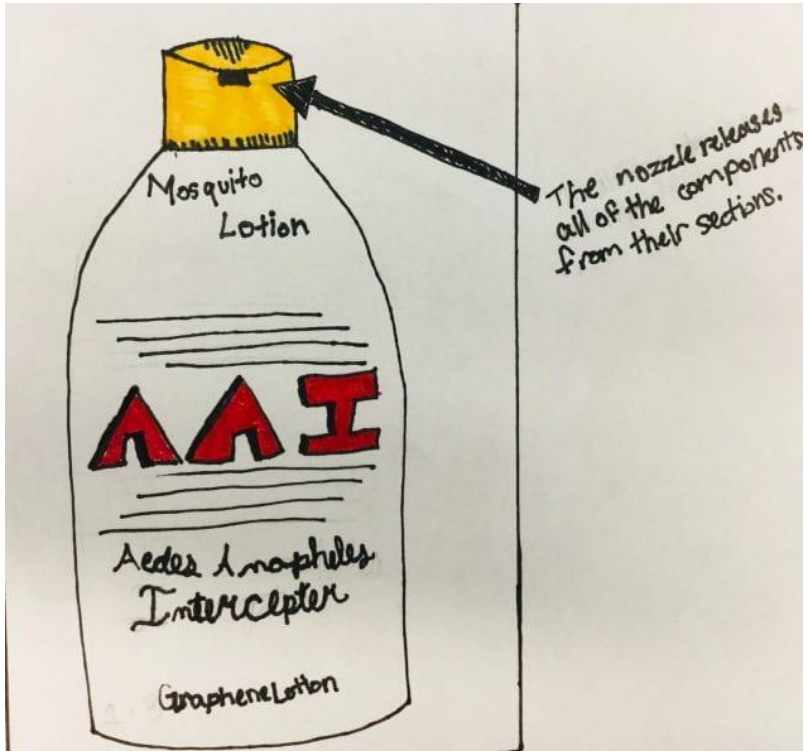
History

Nanotechnology first started when physicists Gerd Binning and Hienrich Rohrer created a new microscope. They called it a Scanning Tunneling Microscope (STM). Its use was to give scientists a new view of matter. This microscope works when a sharp probe is moved over a tiny sample of metal, and an STM can show a scientist individual atoms. The images shown are like a contour map, with dips and bumps to show the atoms' shape.

In 1986, the Atomic Force Microscope (ATM) was created! The difference between the STM and the AFM is that the STM can only look at metal, but the ATM can look at any substance. Not only do these microscopes allow scientists to look at atoms, but to move them too! They did this by using a fine tipped probe to move the atoms around. Being able to look at and move atoms created the science of nanotechnology.

One item that has been created using nanotechnology is graphene. Graphene had been studied in 1947 by P.R. Wallace, but it wasn't really discovered until 2004. In 2004, a physicist named Andre Konstantin Geim and fellow physicist Konstantin Novoselow created samples of graphene sheets through a simple technique: they used adhesive tape on graphite and peeled off the layers. The pair received the Nobel Prize in Physics in 2010 to recognize their discovery.

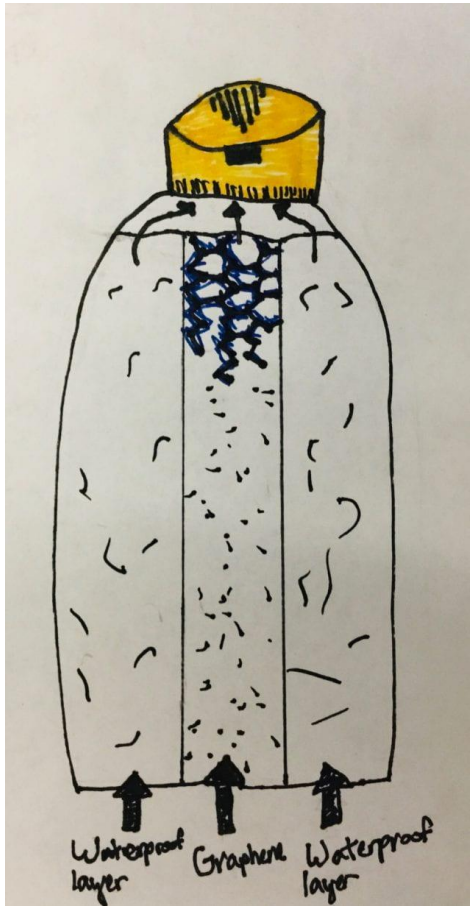
Future Technology – Slide 1



Aedes Anopheles Interceptor (AAI) is a new type protection from mosquitos. It is a lotion that contains suspended graphene. Once applied to the skin, the graphene will create a layer that blocks mosquitoes. Because it contains graphene, it will block mosquitoes in many different ways. Graphene is one atom thick, and because of its honeycomb structure, even the smallest element, helium, can't fit through it. Because of this, the proboscis of a mosquito can't penetrate the graphene, even though a proboscis is extremely thin. The graphene in the lotion also blocks trigger smells that may attract a mosquito. For example, graphene can mask our skin odor, such as sweat, and mosquitoes will not be attracted to us by these smells.

The kind of graphene we will use in the lotion is graphene oxide (GO). Graphene oxide is a single-atom layer of carbon. However, the oxide part comes in with functional groups (oxygen groups). These functional groups are attached to both the sides and the area of a graphene flake. These functional groups, with the way they are attached, causes graphene to no longer be able to conduct electricity. They also allow the flake to become polar, which means it can be dissolved in water.

Future Technology – Slide 2 (optional)

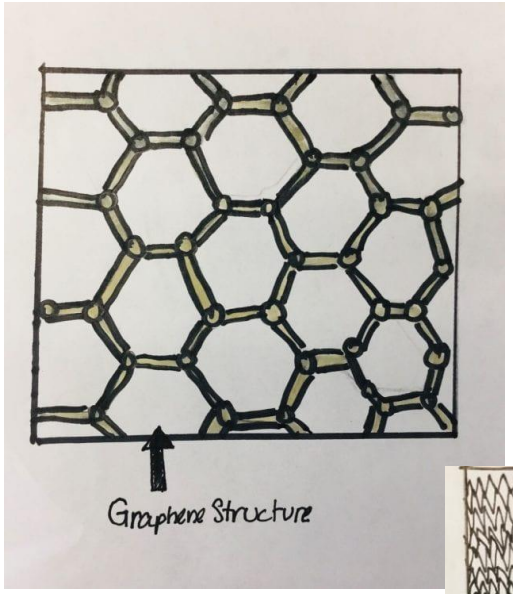


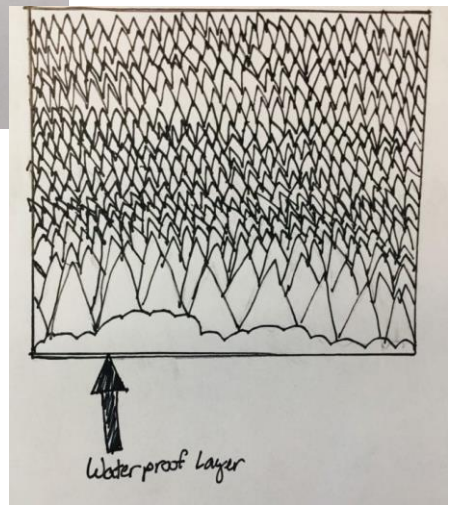
When these graphene oxide flakes are in water, they can be applied to surfaces, and they will form graphene oxide films. This is how our lotion would be applied. The graphene oxide would be in a water solution, and it would form a film once it was applied to a person's skin.

The waterproof coating will be a layer in the lotion that will keep it from turning to a polygel, a result of the lotion and water. It will prevent any liquid, such as sweat or rain, from coming into contact with the graphene.

To keep the graphene layer intact, the waterproof coating is vital for the graphene incorporated in the lotion. The waterproof lotion will be a separate lotion that will be layered on top of the graphene layer. Something important for the waterproof layer is a type of silicon microscopic spike that would keep the water from being absorbed into the graphene layer. Water droplets sit on the microscopic spikes and can't get into the waterproof layer. Today, this type of spike is used on clothes and fabric, but we will find a way to incorporate it into the waterproof layer.

Future Technology – Slide 3 (optional)



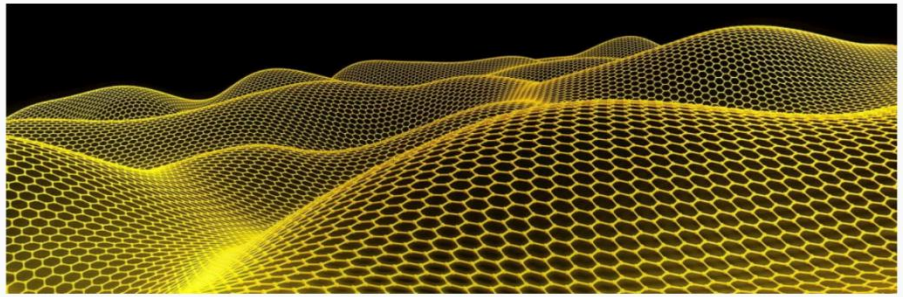


This is the structure of the graphene that goes into the lotion. This is the middle layer in the bottle when they are separated. A limitation of this prototype is that you can only see the representation of the graphene oxide structure, but you can't understand how it blocks mosquitoes from biting just from the drawing.

This is the structure of the nanofilaments that make up the waterproof layers. This is the bread of the sandwich. It's the outside layers of the lotion to keep the graphene from getting wet.

Breakthroughs– Slide 1

Breakthroughs



One breakthrough that will need to happen is the cost of graphene would need to go down tremendously. Graphene is very expensive, going for thousands of dollars a flake, it would be crucial for the cost of graphene to go down, not only for profit, but for packaging reasons. Since the market only gives graphene in large quantities, costing millions of dollars, making only about 200 bottles, if the price of graphene went down, we could order lots of packages at one time making a lot more bottles. Profit is important because a company would need money to continue making AAI (Aedes Anopheles Interceptor).

Another breakthrough is that we need to find a way to make the graphene oxide hold its structure in water. This is why we added the silicon nanofilaments, but in the future better ways may arise. Sweat still holds a threat and our design must make people sure it protects them.

Breakthroughs – Slide 2 (optional)

- N/A

Breakthroughs – Slide 3 (optional)

- N/A

Design Process – Slide 1

Whenever we first started, we debated whether we would make a lotion or a spray. We decided on lotion. But it wasn't so simple. As we developed our idea more we got attached to the idea of a spray. But we couldn't keep the spray water resistant. In the end, we switched back to a lotion, because we thought that we would be able to better secure all layers in a lotion.

Another material called reduced graphene oxide (rGO) came up. Reduced graphene oxide is like graphene oxide (GO) but it holds a strong barrier whether wet or dry. This is unlike GO, (graphene oxide) which cannot hold the barrier when wet. However, rGO isn't breathable and will not allow sweat to move past it. Everyone who would put on the lotion would become hot and sweaty. So, we abandoned the idea of rGO and continued with graphene oxide because it would be better and more breathable with graphene oxide.

Design Process – Slide 2 (optional)

Another idea we decided to discontinue was the idea of making two separate lotions. We were going to have people apply a waterproof layer, then a graphene layer, then another layer on top. But we felt like no one would want to do it and it would be too much work to put it on. We believed it wasn't a real solution because people wouldn't bother to put on three layers of lotion, and they would most likely just use regular bug spray instead.

Design Process – Slide 3 (optional)

N/A

Consequences

One positive consequence of this project will be that diseases carried by mosquitoes such as West Nile and malaria will notably decrease over time, causing fewer deaths because of these diseases. These diseases are terrible and threaten many people. For people who live in areas where mosquito-borne illnesses create large worries, this technology could help their mental and physical health. Stopping these diseases could be revolutionary and positively impact many people around the world.

Another positive is that by using graphene instead of regular bug spray we will cause fewer negative effects that are caused by DEET. DEET can kill insects such as bees and can have negative effects on humans.

One negative eco-consequence will be that female mosquitoes will not get the blood to supply the protein they need to reproduce, causing many mosquitoes to die. Not only will it affect the mosquito population, but it will also affect all other animals that rely on mosquitos for food, especially the bat—which can eat about 600 to 1,000 mosquitos per hour.

Another consequence will be that graphene is very expensive, averaging several thousand dollars per flake, and it only comes to the market in large quantities. This would cause it to be expensive to the public, which would make it hard for anyone to get the safety they need. We hope that the positive consequences would outweigh the negative.

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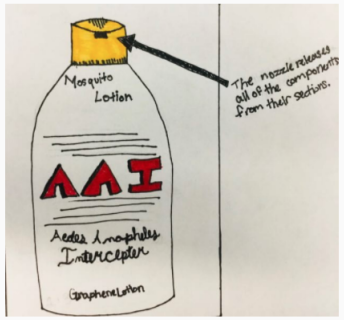
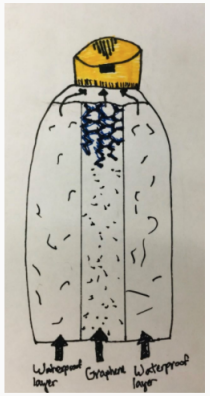
Sample Web page – 1

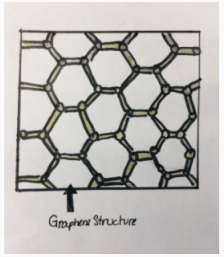
AAI Prototype



The plastic lotion bottle has a top that releases the components from its section in the bottle with all of the layers come together when someone applies it to the skin.

The graphene and waterproof layers will have their own sections to keep the graphene away from the waterproof layers as long as possible. This is also so the substances don't merge together while in the bottle.





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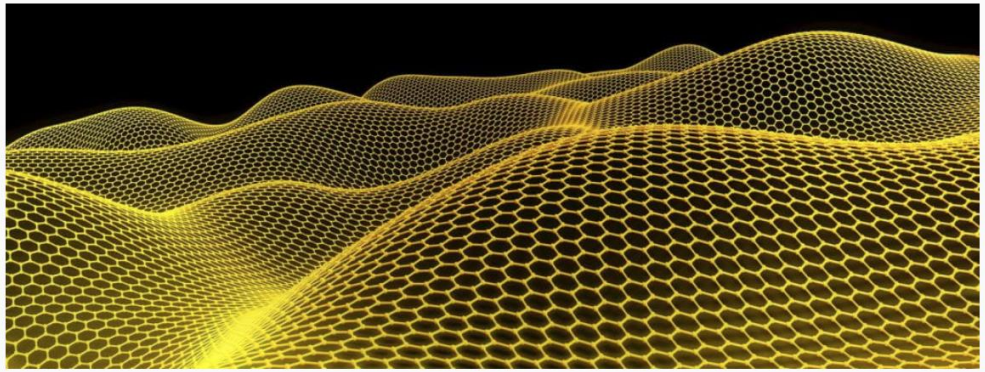
Sample Web page – 2

Breakthroughs



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Sample Web page – 3

AAI – The Future

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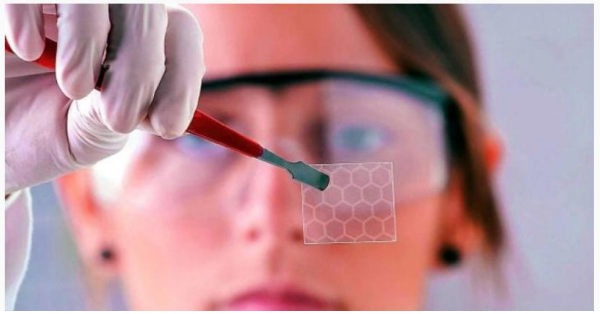

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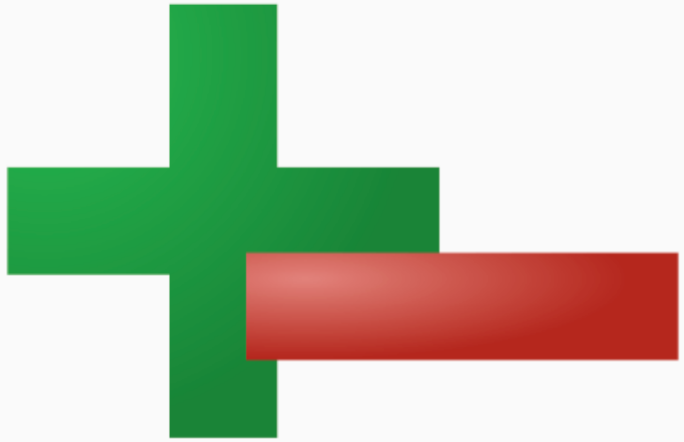
Sample Web page – 4

Consequences



POSITIVE CONCEQUENCES

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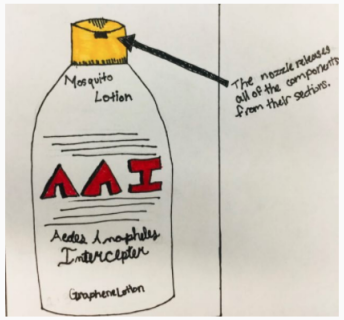
Sample Web page – 5

AAI Prototype



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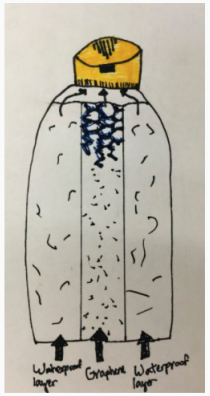

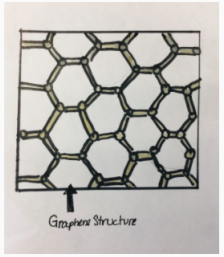

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