Broadcom 2020 Florida Finalists

Amelia Curran

8th Grade, Herbert C. Hoover Middle School
Indialantic, Florida

*Comparing the Efficiency, Free Fatty Acid Percentage, and Carbon Dioxide Emissions of Waste Vegetable Oil and Ethiopian Mustard (*Brassica carinata*) Biodiesels*

Project Background: Amelia learned a lot about car engines and fuels from her dad, who's a retired race car driver. Most cars run on gasoline. Along with emissions from other fossil fuels, these are the main drivers of human-caused climate change. "We must take action to reduce our carbon footprint on this Earth," Amelia says. Biofuels are a possible alternative fuel for cars and trucks. Biofuels are made with materials from plants and other organisms. In some instances, burning them emits less carbon dioxide than regular gasoline. Using biofuels can also avoid fugitive emissions and other pollution from mining or drilling. Amelia wanted to compare homemade biofuels from two plant-based oils. Ethiopian mustard is an oilseed crop, and waste vegetable oil is used cooking oil.

Tactics and Results: First Amelia made her biofuels. She extracted oil from Ethiopian mustard seeds. She also cleaned up the waste vegetable oil and adjusted its level of free fatty acids. Next, Amelia reacted each type of oil with sodium hydroxide, methanol and triglycerides. That process produced fatty esters for her two biofuels. Once the fuels were made, Amelia compared them with typical auto gasoline. First, she tested the fuels' energy content. She burned a small amount of each fuel in a tea candle holder. A metal can of water sat above the flame. After a minute, she extinguished the fire. She measured the change in the water's temperature. Then she converted that into units of energy called joules. Amelia's waste oil fuel wouldn't burn. The gasoline produced more energy than the mustard seed oil fuel. However, that difference wasn't statistically significant. In another round of tests, Amelia collected smoke from the burning fuels. Then she figured out how much carbon dioxide was emitted. Her fuel made with mustard seed oil gave off significantly less carbon dioxide than the gasoline.

Other Interests: "I have been dancing since I was three years old," Amelia says. Her other hobbies are playing the piano and guitar and singing in a choir.

Career Interest: Amelia is especially interested in criminal and abnormal psychology and wants to pursue a career in criminal justice.

Elise Rina

8th Grade, Lake Eola Charter School
Orlando, Florida

Access Granted

Project Background: Far too often, parents accidentally lock young children in cars. And if the car gets too hot, a child faces serious injury or death. A friend of Elise's family once accidentally locked both her child and her keys in a car. The friend immediately saw the danger and called the police. If the car got too hot, the child could face injury or even death. "She called the police, but had to end up breaking her window because it was taking too long," Elise says. She had seen another girl's project, which would turn on fans in the car. But that still left the child inside. Elise set out to design a solution that would get the child out.

Tactics and Results: "I took an infant car seat and redesigned it to allow access to kids locked in cars," Elise says. For starters, she added a pressure sensor and a temperature sensor. The temperature sensor is activated when heat inside the car reaches a preset level. If that happens and if a child is in the seat, buzzers sound off and lights flash. "But the thing that makes this project different is that the car window will lower," Elise says. That happens because the system also connects to the motor that controls an electric car window motor. The lowered window lets cooler air into the car. It also makes it easier for someone outside the car to rescue the child. Elise used a series of if/then statements to program an Arduino circuit board to control everything. She tested her design to make sure it would work when it should, but not give off false alarms. She also made sure the buzzers were loud enough to draw attention in someplace like a parking garage. That increases the chances that someone passing by will spot the locked car and provide help.

Other Interests: Elise enjoys playing soccer and basketball. She's also active in her local Boys & Girls Club. And she volunteers for a recycling group called Clean the World.

Career Interest: Elise hopes to become an imagineer. People with that career "get to think up new things that nobody has ever done before and then make it happen," she says.

Logan Silvea

7th Grade, Holy Trinity Episcopal Academy
Melbourne, Florida

Correlation Between Interocular Signal Delay and Luminosity, Measured Through the Perceived Intensity of the Pulfrich Effect, Noting the Impact of Ocular Dominance (2 Year Study – Psychological Adaptations and Optical Illusions)

Project Background: Logan was born with only 20/100 vision in both eyes. But he didn't realize it until third grade. "I was able to read, hit a baseball and do many other normal activities," he explains. Basically, his brain had been adapting and filling in many of the visual gaps. When Logan learned that, he became interested in optical illusions. For his project, he tested a phenomenon called the Pulfrich Effect. It makes images moving from side to side on a flat screen seem to be in 3D. The trick calls for the use of a darker filter for one eye.

Tactics and Results: The Pulfrich effect works because of how the brain handles signals from the eyes. A darker filter for just one eye causes a tiny time delay in when the brain gets information from that eye. Meanwhile, the brain is processing signals from the other eye. The brain thus processes two images at once. So, if a pendulum moves from side to side on a flat surface, a person's brain interprets that as 3D motion. Logan mounted a movable pendulum on flat poster board. Forty-one people then viewed the moving pendulum while wearing different sets of sunglasses. Each pair let a different level of light reach either the left or right eye. People perceived the 3D effect as being most intense when they viewed the illusion with glasses having the darkest filter for one eye, Logan reports. He also saw a correlation between the intensity of the effect and people's eye dominance. About 60 percent of the subjects perceived the greatest impact when their weaker eye had the darker filter. Better understanding about how the brain deals with visual signals might help to screen and treat various physical and mental conditions, Logan says.

Other Interests: Logan plays quarterback for his football team and shortstop on his baseball team. He also enjoys fishing, playing the guitar and painting ocean scenes.

Career Interest: Logan hopes to become a neurologist. "I want to understand how our brain receives new information and interprets that information."

Zoe Weissman

8th Grade, American Heritage School
Plantation, Florida

Testing Phytochemicals for Antinocicepetive Properties in Both Female and Male Drosophila melanogaster *in Order to Discover a Natural Painkiller and Reduce Bias in the Drug Industry*

Project Background: "I wanted to find a potential alternative to opioids that could treat males and females equally," Zoe says. Ideally, she hoped to do that with plant-based chemicals. She also wanted to make sure the chemicals would help both sexes. On average, she learned, men and women often perceive pain differently. However, clinical trials for new drugs have tended to use more men than women. That habit came about from a now-disproven notion that women's hormone cycles make them harder to work with. As a result, more pain medicines are geared towards men, Zoe notes. In her view, that's unfair to women. It can also pose dangers if harmful side effects go unnoticed.

Tactics and Results: Zoe tested three plant-based chemicals on male and female fruit fly larvae. Salicin comes from willow bark and some other trees. Caffeine comes from coffee beans, tea leaves, cocoa beans, kola nuts and other sources. Finally, cinnamic acid comes from cinnamon and some other trees. To test each chemical, Zoe used separate groups of male and female larvae. She also treated groups of males and females with acetaminophen, an over-the-counter pain reliever. Control groups for each sex got no treatment. Zoe first measured the temperature at which larvae in different groups reacted to heated water. Another test counted how many insects in each of the ten groups flew past a hot zone to get to a source of light. In a third test, she poked larvae with a small filament. She noted if the insect reacted to the stimulus within 10 seconds. All three plant-based treatments reduced the male and female flies' pain compared to the control groups. Among the three plant-based treatments, salicin worked best for both the hot water and the poking tests. Cinnamic acid was the best plant-based treatment to let flies move towards the light.

Other Interests: Zoe volunteers with a program to build friendship with kids who have special needs. She has also been a chapter president of March for Our Lives.

Career Interest: "I dream of becoming a pediatric heart surgeon," says Zoe. She looks forward to hands-on work that can help save patients' lives.