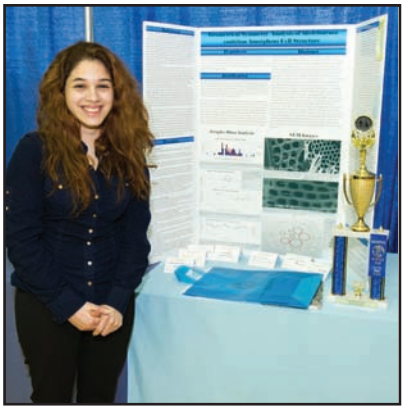
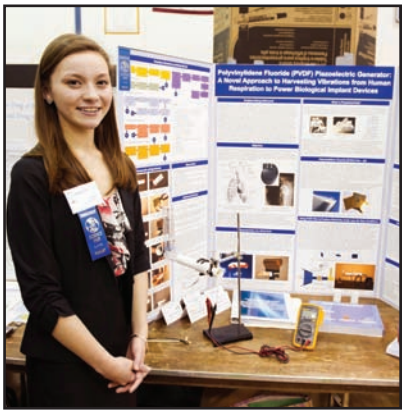
CONNECTICUT SCIENCE & ENGINEERING FAIR
& SCIENCE HORIZONS at the
INTEL INTERNATIONAL SCIENCE & ENGINEERING FAIR
Pittsburgh, Pennsylvania, May 13 - 18, 2012

Meet the Winners

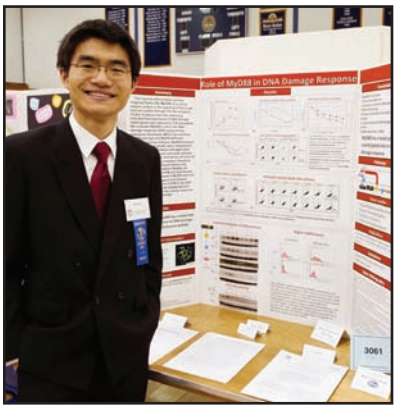
Connecticut Science Fair ISEF Winners– l-to-r: Ann Frattalone,ISEF Coordinator, Genesis Garcia, Mallory Madfes, Bridget Oei, Ryota Ishizuka, John Solder, and Yiyuan Hu



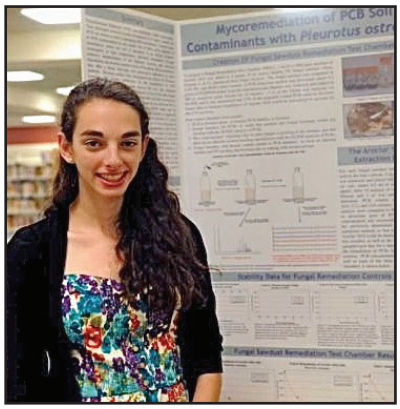
Genesis Garcia, Senior, Bridgeport Aquaculture S
1st Place, Urban School Challenge



Bridget Oei,Sophomore, East Catholic HS
2nd Place, Dominion Physical Sciences

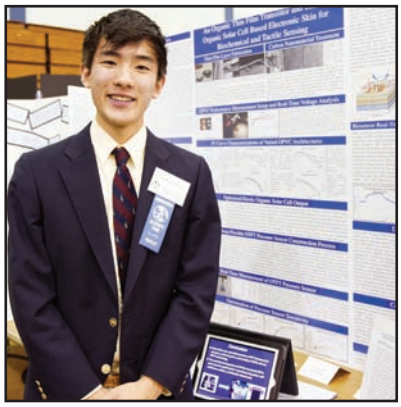


Yiyuan Hu, Senior, Hamden HS
2nd Place, Pfizer Life Sciences

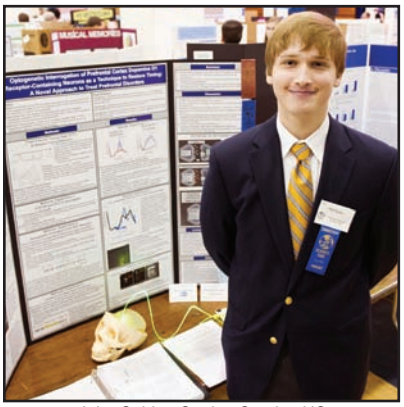


Mallory Madfes, Junior, Greenwich HS
3rd Place, Pfizer Life Sciences

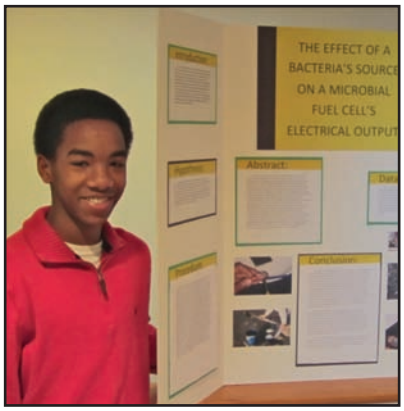
Samantha Skaller, Junior, Brewster HS
Winner, Science Horizons



Ryota Ishizuka, Senior, Greenwich HS
1st Place, Dominion Physical Sciences



John Solder, Senior, Staples HS
1st Place, Alexion Biotechnology
1st Place Pfizer Life Sciences



Jaden Williams, Junior, New Milford HS
Winner, Science Horizons

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CONNECTICUT SCIENCE & ENGINEERING FAIR

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Intel International Science Fair Competitor
2012 Connecticut Science Fair

(Student information as of April 2012)

Genesis Garcia, Grade 12

Bridgeport Aquaculture School, Bridgeport, CT

Geometrical Symmetry Analysis of the Skeletonema costatum Amorphous Cell Structure

Connecticut Science Fair Awards

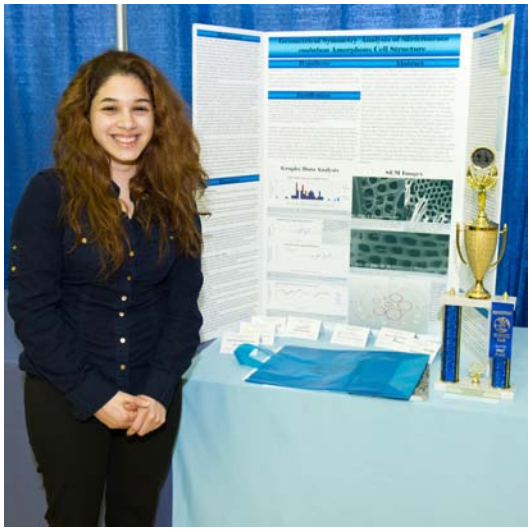
- Urban School Challenge Awards --- 1st Place High School - $500 and Trophy, Medallion and trip to compete at Intel Int. Sci. & Eng. Fair

Abstract

S. costatum, a common species of diatom native to coastal waters around the world, typically grows in chains or colonies. Each cell is conjoined by long processes or marginal spines to form filaments. Like other diatom species, S. costatum contains a frustule (cell wall), the main component of the silica structure. After cell division, within the frustule, the Silicon Deposition Vesicle (SDV) forms and expands constructing complex radial symmetrical shapes of areolae (pores), spiral processes (ribs) and girdle bands called cincture. These microscopic photosynthetic organisms contain a periodic nanostructure composed of silica that suggests an ideal areolae formation for the potency of solar panel efficiency. Understanding the S. costatum amorphous silica pattern within its porous structure can lead to a pattern model that, if replicated in photocatalyst and solar cell construction, will greatly improve the solar cell's energy output. To develop a pattern model, in-depth analysis of SEM (Scanning Electron Microscope) imagery including, length-width ratios of individual areola, the average count and the relative distribution angles of the areola interprets S. costatum's frustule geometry. Examining the S. costatum in girdle view around the cylindrical can shape of the diatom at 20,000x magnification, exposed a hexagonal outline pattern comprised of seven individual areolae with significant asymmetrical alterations. The individual areolae "positioning" at 62° +/- 2°, relative from center dimensions, with an areola mean dimensional range of .04um length and .03um width respectively. The distribution angles coupled with the dimensional ranges within this hexagonal outline pattern define the final frustule formation. Interpreting this intricate mold of the areola can help understand how this growth pattern forms during the pre-stages of cell division that can potentially be applied to solar panel construction for improved efficiency.

Biography

Genesis Garcia is a senior at Bridgeport Regional Aquaculture Science and Technology Education Center. This was her first year participating in the Connecticut Science and Engineering Fair. She is currently enrolled in an intensive college program offered exclusively to seniors in her school known as the Bridgeport Aquaculture College Alliance. The program offers two University of Connecticut credit classes, Environmental Science and Oceanography. Through this program Genesis also received training on the usage of the scanning electron microscope, which she utilized for her project. Her project dealt with the geometrical analysis of diatoms, specifically focusing on the species *Skeletonema costatum's* amorphous cell structure in relation to its photosynthetic abilities. Detailed images of the species *S.costatum* were observed and analyzed, focusing on every aspect of its unique structure. This analysis led Genesis to develop a novel 3D model of the diatom's nanostructure which can be imprinted onto solar cells to improve their efficiency. She is a highly motivated and energetic individual who intends to study bioengineering at Sacred Heart University in the fall.



CONNECTICUT SCIENCE FAIR

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Top Winners in the 2012 Connecticut Science Fair

(Student information as of April 2012)

Yiyuan Hu, Grade 12

Hamden High School, Hamden, CT

Role of MyD88 in DNA Damage Response

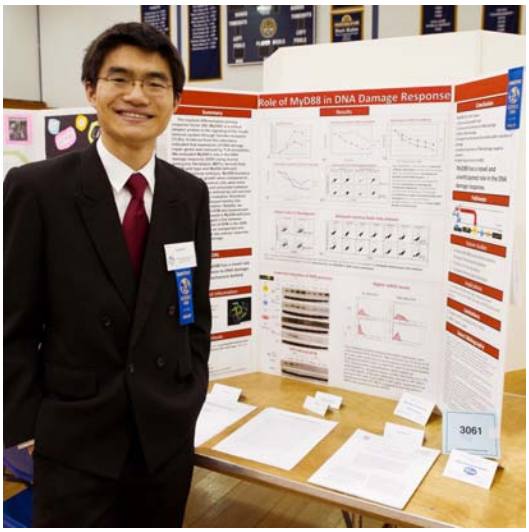
Connecticut Science Fair Awards

- Pfizer Life Sciences Awards --- 2nd Place- Life Sciences Senior High- $300 & trophy, Trip to compete at Intel ISEF
- Society for In Vitro Biology --- Certificate and $50 gift card to Amazon given by CSF

Abstract

The myeloid differentiation primary response factor-88 (MyD88) is a critical adaptor protein in the signaling of the innate immune system through Toll-like receptors (TLRs). Evidence from this laboratory indicated that expression of DNA damage repair genes was induced by TLR stimulation while previous studies have suggested a protective role for MyD88 in diseases well characterized by high levels of reactive oxygen species (ROS). We evaluated MyD88's role in the DNA damage response (DDR) and ROS production using murine embryonic fibroblasts (MEFs) derived from MyD88 wild type and MyD88-deficient (knockout) mouse embryos. MyD88 knockout MEFs had less growth when compared to that of wild-type MEFs and were more sensitive to ionizing and ultraviolet radiation than wild-type cells as defined by cell survival seven days following irradiation. Knockout cells also exhibited delayed reentry into mitosis following irradiation. Notably, we show that induction of critical DDR proteins such as P53, phosphorylated P53, and Chk2 is decreased in MyD88-deficient cells. Our results suggest that MyD88 is a protector against mitochondrial ROS. Preliminary data also imply the nuclear localization of MyD88 and the possibility of direct binding with a critical DDR protein kinase. Taken together, these results suggest an unexpected and novel role for MyD88 in the cellular response and repair of DNA damage.

Biography



Yiyuan Hu is a senior at Hamden High School and conducted research on a novel role for the adaptor protein MyD88, which is critically implicated in the activation of the innate immune system through the Toll Like receptors. In addition to receiving 2nd place at the 2011 and 2012 Connecticut Science fairs, Yiyuan also won 1st place at the Connecticut Junior and Science Symposium. He aspires to concentrate in molecular and cellular biology and become a doctor and researcher. Yiyuan was a member of the varsity indoor and outdoor track teams, winning gold in the SCC, Hartford public, and CT State opens invitational. He is currently the president of the astronomy and science clubs as well as a member of the jazz band, math team, and the Human relations club. Yiyuan is also an award winning artist and trumpet player. Yiyuan will attend Harvard College later this fall.

CONNECTICUT SCIENCE FAIR

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Trip Winner to the
Intel International Science and Engineering Fair

Ryota Ishizuka, Grade 12

Greenwich High School, Greenwich, CT

Project Title: An Organic Thin Film Transistor and Elastic Organic Solar Cell Based Electronic Skin for Biochemical and Tactile Sensing

Connecticut Science Fair Awards

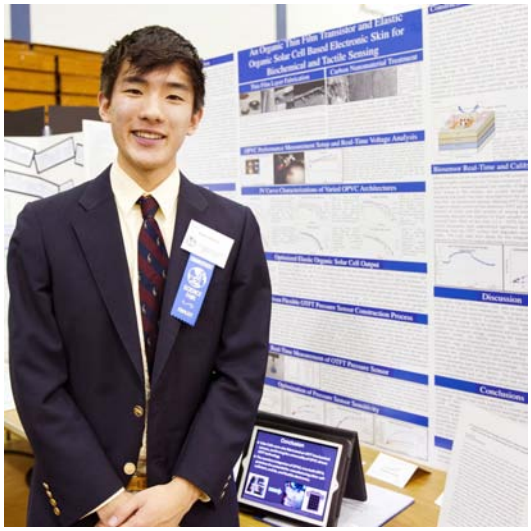
- Dominion's Millstone Power Station Physical Sciences Awards --- 1st Place - Physical Sciences Senior High Individual - $500 & trophy, trip to compete at Intel ISEF
- United Technologies Corporation Awards --- $500 in UTC Common Stock, Plaque, Backpack, Book, and Annual Report
- H. Joseph Gerber Medal of Excellence, an award of the Connecticut Academy of Science and Engineering in partnership with CCAT --- Physical Sciences Senior - $1,000 cash, Solid Silver Medal of Excellence, invite to
- Office of Naval Research- U.S. Navy / U.S. Marine Corps --- High School- Certificate, $75.00 gift certificate
- IEEE, Connecticut Section --- $250 Honors Award -Senior
- Coherent, Inc. Richard Hart Award for Excellence in Photonics --- $300 cash, plaque, invitation to lunch and tour Coherent factory
- Arthur Mensing Award --- $500 cash award for excellence in the physical sciences

Abstract

Organic Thin Film Transistors (OTFTs) are low-cost and scalable electronics that have been limited by their dependence on external power sources. The development of stretchable Organic Photovoltaic Devices (OPVCs) would allow for solar harvesting on non-planar surfaces of textiles, vehicles, and buildings or integration into such OTFT electronics to provide portable energy. This study demonstrates flexible OTFT pressure sensors powered by elastic OPVCs, which may serve as electronic skin mimicking tactile sensing for artificial intelligence. Compressive strains were applied to a PDMS elastomer of OPVCs with e-GaIn liquid metal top contacts and grapheme oxide base layers, creating elastic film buckles. PDMS substrate and thin film thicknesses were analyzed by Spectral Reflectance, SEM, and EDS to optimize outputs. Optimized elastic OPVCs generated 0.56V at a PCE of 2.56% while stretched to 120%, paralleling production from conventional rigid OPVCs. Compression of the PDMS dielectric in OTFT pressure sensors produced changes in device capacitance and output current corresponding to the applied pressure. Sensitivity was maximized with varying substrates, organic semiconductors, and electrodes. OTFTs detected minute pressures of 500 Pa with a rapid response of 0.2 seconds. Adaptability of OTFT applications was demonstrated through a biosensor OTFT with laminated flow cell that converted the binding of negative biomolecules to current changes. Label-free detection of trace elements of biotin and SDS was achieved with CuPc surface passivation films, which potentially allow for multiple analyte discriminating sites. The novel elastic, collapsible, and robust OPVCs may serve as off-grid power for a new generation of flexible and self-powered consumer and biomedical devices.

Biography

Ryota is a senior at Greenwich High School. Last year, he presented his project entitled "Optimization of a Microbial Fuel Cell to Drive a Bioelectrochemically Assisted Wastewater Treatment Reactor" at both ISEF and I-SWEEEP. He was awarded 3rd place in the Energy and Transportation category and a silver medal, respectively. This year, Ryota developed a novel stretchable solar cell that allows for energy harvesting on textiles, vehicles, and buildings, or integration into small-scale electronics to provide portable power. Such technology promises a new generation of flexible and self-powered consumer and biomedical devices. He received 1st place in both the CT Science Challenge and the CT Junior Science and Humanities Symposium and will be presenting at the National JSHS conference. Ryota is both a Siemens and Intel Science Talent Search Semifinalist and was one of 80 students internationally selected to attend the Research Science Institute (RSI) over the past summer. In school, he serves as the captain of both the cross country and indoor track teams, which placed 2nd in the state championships. Ryota is also the captain of the state-winning math team and has individually placed first in the New England competition and represented the state in the national competition. A National Merit Scholarship finalist, he is fluent in three languages and has individually studied all subjects of the Japanese curriculum. Ryota hopes to major in applied math or engineering at either MIT or Harvard University.



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Trip Winner to the
Intel International Science and Engineering Fair

Mallory Madfes, Grade 11

Greenwich High School, Greenwich, CT

Project Title: Mycoremediation of PCB Soil Contaminants with Pleurotus Ostreatus

Connecticut Science Fair Awards

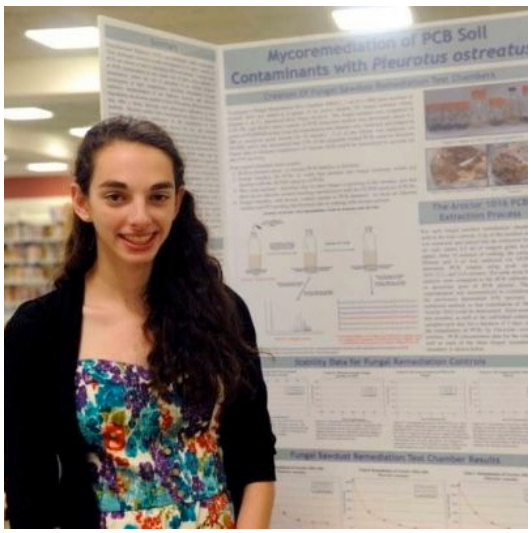
- Pfizer Life Sciences Awards --- 3rd Place- Life Sciences Senior High- $200 & trophy
- Audubon Connecticut & Arch Chemicals Environmental Awards --- 3rd Place HS- $100, Trophy, Audubon gifts
- eesmarts/CT Energy Efficiency Fund Future Sustainability Awards --- 3rd Place High School - $300 Cash and Trophy
- Goodrich ISR Awards for Excellence In Engineering --- $1,000 Cash and plaque
- U.S. Metric Association --- Certificate & $50 gift card to Amazon given by CSF
- Long Island Sound Foundation, Inc. --- $500 Life Science/Environmental Science/Physical science
- GENIUS Olympiad --- GENIUS Olympiad Competition for HS student (s) and advisor - Environmental

Abstract

Polychlorinated Biphenyls (PCBs) are remarkably stable compounds. Their resilience in the environment is of major concern due to their damaging effects on humans. Current cases of PCB contamination in soil require one of three costly methods of remediation; soil is unearthed to an off-site location with high temperature incineration, microbial degradation through reductive dechlorination of the biphenyl skeleton, and chemical degradation via electron transfer to form PCB anions. Mycoremediation may offer a cheap, thorough, and noninvasive alternative to these methods. Previous studies have investigated the effects of *Pleurotus ostreatus (PO)* in the remediation of PCB contaminated liquids, with some success for low and moderate contamination. This research instead focuses on use of PO fungus in the mycoremediation of PCB's in a controlled soil-like medium. 1000 ppm Aroclor 1016 was added to 4 g of pre-cultivated PO in pine sawdust, which contained 2.4% fungus, 69.8% water, and the remaining sawdust. An extraction method was created to reliably recover PCB content from the sawdust mixture; 0.2 g of contaminated fungal sawdust was mixed with 0.5 ml of hexane for 10 min, followed by filtration. Gas chromatography (Flame Ionization Detection) was used to measure the PCB content of soil with PO fungus. Results indicate that the PCB concentration in untreated sawdust remained constant over time, while those chambers with a thriving PO colony showed as ~ 60% reduction in PCB content in 1 day. In five days of PO treatment, as much as 99.6% of the original load of 1000 ppm Aroclor 1016 was remediated, with only 4 ppm remaining. The rate of remediation per load of PO in the soil-like medium was determined to be 24.4 ppm PCB per day, per gram of PO, within 1 kg of soil.

Biography

Mallory Madfes is a junior at Greenwich High School enrolled in the Honors Science Research program. This is her first year competing at the Connecticut Science Fair. Her research focused on mycoremediation of Polychlorinated Biphenyl (PCB) soil contaminants with Pluerotus Ostreatus. Mallory was successful in finding a more efficient and less expensive method of remediation with a biological agent. She is also active in her schools Habitat for Humanity club, student government, and a coxswain for the Greenwich Water Club's varsity crew team. Mallory is currently looking into colleges and plans to major in engineering.



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Trip Winner to the
Intel International Science and Engineering Fair

Bridget Oei, Grade 10

East Catholic High School, Manchester, CT

Project Title: Polyvinylidene Fluoride (PVDF) Piezoelectric Generator: A Novel Approach to Harvesting Vibrations from Human Respiration to Power Biological Implant Devices

Connecticut Science Fair Awards

- Dominion's Millstone Power Station Physical Sciences Awards --- 2nd Place- Physical Sciences Senior High Individual - $300 & trophy, trip to compete at Intel ISEF
- ATOMIC (Associated Teachers of Mathematics In CT) Mathematics Awards - with People's United Bank --- High School Finalist - Medallion & Acrylic Award
- Clean Energy Finance and Investment Authority Alternative/Renewable Energy Awards --- 1st Place High School - $500 Cash and Trophy
- eesmarts/CT Energy Efficiency Fund Future Sustainability Awards --- 2nd Place High School - $500 Cash and Trophy and Trip to Compete I-SWEEEP, Houston
- Goodrich ISR Awards for Excellence In Engineering --- $1,000 Cash and plaque
- United Technologies Corporation Awards --- $500 in UTC Common Stock, Plaque, Backpack, Book, and Annual Report
- Alexion Biotechnology Awards --- 5th Place- Biotechnology Senior High- trophy
- Office of Naval Research- U.S. Navy / U.S. Marine Corps --- High School- Certificate, $75.00 gift certificate1
- CT Technology Council Youth Innovation Award --- $150 Cash Award for Technological Innovation
- I-SWEEEP (International Sustainable World Project Olympiad) --- I-SWEEEP Competition for student (2) and advisor - 2nd Place HS Future Sustainability

Abstract

Traditional batteries used in biological implants require the patient to undergo invasive surgery during the replacement process. One promising solution is to directly harvest energy from the biological system itself to realize self-powered biomedical devices. This research explores the development of a practical micro-scale device for harvesting energy from a regular human activity—respiration. The energy harvesting relies on the resonant oscillation of a piezoelectric generator whose prime component is a PVDF thin film shaped in a flapper, reed or wind sock configuration. Piezoelectric Generators with PVDF thin film thickness of 26, 52 and 100 microns were tested to investigate their capability of converting low-speed air flow energy into electricity. Experiments indicated that the peak power generated increased as a function of the cubic power of the peak airflow velocity. Greater power was produced by PVDF of decreasing thickness. This correlated with the prediction from the mathematical model. The wind sock configuration produced the greatest power for a given PVDF thickness throughout the range of peak airflow velocity. This was followed by the flapper configuration and then the reed configuration. The best configuration tested was the 28 micron thick PVDF film in the wind sock configuration. PVDF oscillations and power was produced with airflow velocity as low as 3.4 ft/sec. In the range of human breathing velocity (10 ft/sec to 25 ft./sec), this configuration produced between 10 to 110 microwatts. At a peak of 10 microwatts, a pacemaker is the largest consumer of electricity of any biomedical device. The low end of the PVDF Piezoelectric Generator power range is sufficient to power a pacemaker at its peak requirements. The PVDF Piezoelectric Generator tested produced more than sufficient power to operate this device.

Biography

Bridget Oei is a sophomore at East Catholic High School. This was Bridget's fourth year competing in the CSF. In 2009 and 2010, Bridget finished in first place for physical sciences in the Middle School division at the CSF. She is a two time Grand Award Winner and gold medalist at the International Sustainable World (Energy, Engineering, Environment) Project Olympiad. Bridget was Freshman Class President and is currently a Sophomore Senator in East Catholic's student government. She is a member of the East Catholic debate and mathematics team. Bridget enjoys the arts as well. She has competed in Ireland and Scotland as a six time Irish Dancing Championship World Qualifier and an All-Ireland medalist. She is currently ranked 8th in North America and 3rd in New England. Bridget is a classical ballet instructor and soloist for Connecticut Concert Ballet. She has been accepted into intensive programs at the American Ballet Theatre, Rock School of Ballet and Boston Ballet. She also received a grant to develop and supervise an art and dance program for The Grace Academy, an independent school providing education to girls of all faiths from low-income families residing in Hartford's inner city neighborhoods. Miss Bridget, as her students call her, also plays the piano and Irish fiddle, having received training from renowned Donegal fiddler, P.V. O'Donnell. In the future, Bridget hopes to continue her pursuit of a wide range of interests in academics, and the arts as well as continue to develop her work in science research.

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Intel International Science Fair Competitor
2012 Science Horizons Science Fair

(Student information as of April 2012)

Samantha Skaller, Grade 11

Brewster High School, Brewster, NY

Isotropic Versus Anisotropic Materials: Affect on Violin Resonance Using Young's Modulus

Science Horizons Awards

1st Place High School Physical Sciences - Science Horizons

Abstract

Playing a stringed instrument sparks the interest of how the sound is made, and what can make it better. The small manipulation of sound post placement transforms the sound, but what happens if the material of the sound post is completely changed? With the help of experienced mentors in the fields of violin making and audio-recording the experiment was made possible. Categorizing each sound post as either isotropic or anisotropic, the materials I chose to use include: Spruce wood, maple wood, carbon fiber, nickel, titanium, PVC, nylon, and polyurethane. After inserting a new sound post consistently inside the violin, I bowed each string of the violin with a consistent pressure and speed inside a professional sound studio. Using a spectrum analyzer, the visual pictures of the sound waves showed the frequencies of the harmonics each string produced with each sound post. An ideal yet implausible sound wave would have consistent peaks of the same height. After gaining the data, I graphed the findings and interpreted them. There were no trends between the behavior of the sound post materials and Young's modulus. The differences between the behavior of isotropic material and anisotropic material were minimal thus drawing conclusions from a musical perspective. Musically, one sound post could produce a bright sounding upper register (maple wood) or a deeper sound (PVC.)

Biography

Samantha Skaller is a junior at Brewster High School. She has been playing viola in the school orchestra since age eleven. Music has always interested her; specifically the science of acoustics. Her experiences at NYSSMA, Eastern U.S Music Camp, Interlochen Arts Camp, and many other musical programs have bolstered her interest in the sound of stringed instruments. Foundations to Science Research (a class dedicated to furthering the research of student's interests) has given her the opportunity to explore the characteristics of the sound of stringed instruments. With the help and guidance from Mr. Edward Schmidt (The teacher of the Foundation to Science Research) Mr. Robert Isley (a local violin maker) and Mr. Richard Abramson (a sound technician) Samantha was able to complete the project entitles: Isotropic Versus Anisotropic Violin Sound Post Materials: Affect on Violin Resonance Using Young's Modulus. Specifically targeting at violins, this project entails aspects from a physical and scientific perspective, as well as from a musical perspective. With this project Samantha competed in Science Horizons Science Fair in Danbury, Connecticut and received an engineering award from Yale University along with the overall winning prize for the Senior Physical Category. Included with these prestigious awards, she has been invited to compete in the Intel's ISEF held in Pittsburgh, Pennsylvania. In the future Samantha hopes to continue her research on this topic that interests her so much.

CONNECTICUT SCIENCE FAIR

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Trip Winner to the
Intel International Science and Engineering Fair

John Solder, Grade 12

Staples High School, Westport, CT

Project Title: Optogenetic Interrogation of Prefrontal Cortex Dopamine D1 Receptor-Containing Neurons as a Technique to Restore Timing: A Novel Approach to Treat Prefrontal Disorders

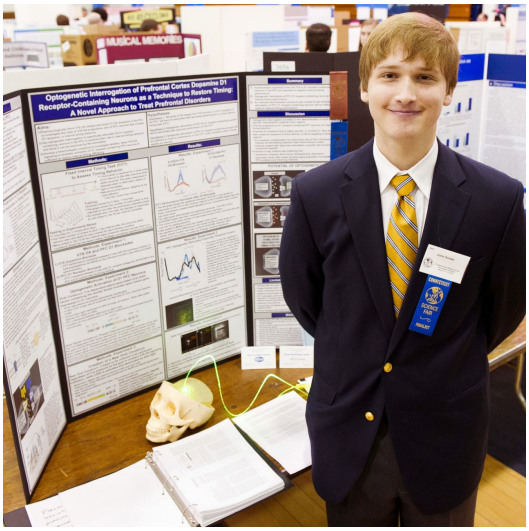
Connecticut Science Fair Awards

- Pfizer Life Sciences Awards --- 1st Place- Life Sciences Senior High- $500 & trophy, Trip to compete at Intel ISEF
- Goodrich ISR Awards for Excellence In Engineering --- $1,000 Cash and plaque
- H. Joseph Gerber Medal of Excellence, an award of the Connecticut Academy of Science and Engineering in partnership with CCAT --- Life Sciences Senior - $1,000 cash, Solid Silver Medal of Excellence, invite to CASE
- Alexion Biotechnology Awards --- 1st Place- Biotechnology Senior High- Trip to compete at Intel ISEF, $500 & trophy,
- Connecticut Science Supervisors Association --- $125 for a high school project

Abstract

Millions suffer debilitating prefrontal cortex (PFC) impairments. Current treatment options are limited; medications affect molecular mechanisms systemically and deep brain stimulation is region- but not mechanism-specific. This project used novel optogenetic interrogation methods to study: 1) the role of ventral tegmental area (VTA) dopaminergic projections and dopamine D1-receptor containing PFC neurons in the control of timing behavior, a relatively understudied PFC function critical to daily activities, and 2) optogenetics as a mechanism- and region-specific approach to treat PFC impairment. In work performed in collaboration with a team of university researchers, impaired interval timing performance of rats was observed after dopaminergic blockade both in the VTA and of PFC dopamine D1 receptors, supporting the importance of this brain system in timed responses. Performance improved after PFC fiberoptic light delivery to mice that expressed 473nm, blue laser light-sensitive activating channels, Channelrhodopsin-2, specifically in dopamine D1 receptor-containing neurons. This showed PFC D1 neuron optogenetic stimulation can improve PFC-related timing performance. Constructs were developed to test a final hypothesis that optogenetic stimulation of postsynaptic PFC D1 receptor-containing neurons, via blue light sensitive activating Channelrhodopsin-2, is sufficient to compensate for a loss of VTA dopamine signaling in mice expressing unfloxed 590nm yellow light-sensitive inhibitory channel halorhodopsin in VTA neurons. The findings demonstrate the importance of PFC D1 neurons in adaptive control of timing responses and provide a novel optogenetic treatment model for PFC disorders, including those arising from impairments upstream.

Biography



John Solder is a senior at Staples High School in Westport. In research in Dr. DiLeone's laboratory at Yale University, John worked with the new technology optogenetics, in which light of specific wavelengths is delivered via fiberoptics to genetically-modified cells to activate them. He demonstrated the potential of optogenetics to provide new ways to treat brain disorders using light. In addition to placing first in Biotechology and in Life Sciences at the 2012 CSF, John was one of the six individual national finalists for the Siemens Competition in Math, Science and Technology in 2011. He was a finalist of the CT Junior Science and Humanities Symposium and Christopher Columbus Foundation-U.S. Chamber of Commerce Life Sciences Student Award. John received a Neuroscience Research Prize from the American Academy of Neurology and presented a poster at their meeting in New Orleans in April. John is a National Honors Society member. He has captained his high school's robotics team that placed first in the FIRST Tech Challenge Robotics World Championship in 2011. He founded a software development team at his high school that created a children's math game for the One Laptop Per Child (OLPC). John plays classical and jazz bass with his high school's Symphonic Orchestra and Jazz Band, played with the Norwalk Youth Symphony and performed at Carnegie Hall and Tanglewood Seiji Ozawa Hall. John will be attending Yale where he will continue to pursue scientific research. He will represent CT at the International Science and Engineering Fair in May.

CONNECTICUT SCIENCE & ENGINEERING FAIR

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Intel International Science Fair Competitor
2012 Science Horizons Science Fair

(Student information as of April 2012)

Jaden Williams, Grade 11

New Milford High School, New Milford, CT

The Effect of a Bacteria's Source On A Microbial Fuel Cell's Electrical Output

Science Horizons Awards

1st Place High School LIfe Sciences- Science Horizons Regional Science Fair

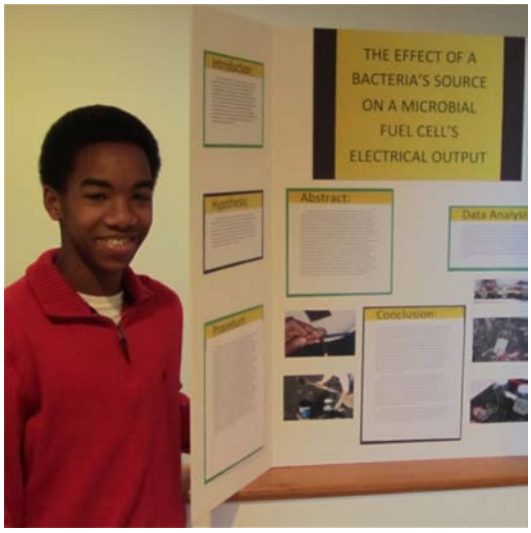
U.S. Air Force Special Award for an Outstanding Science or Engineering Fair

Abstract

Microbial fuel cells (MFCs) have the potential to be an answer to the world's growing necessity for a renewable, "green" energy source. They are versatile and can be cheaply made giving them the ability to be used across the globe and have a variety of potential applications. This experiment will help determine how sources of bacteria influence the electricity produced by a MFC. Three two-chambered MFCs, one for each bacteria source, were constructed. Both mud and water samples were collected from the Housatonic and Aspetuck Rivers. These samples were placed in two MFCs. The third MFC, the control, used rocks and tap water in place of the mud and water samples. During the experiment, the MFCs ran for 14 days and the voltage reading was recorded twice every day at the same time for each MFC. It was hypothesized the more electrochemically active bacteria from the Housatonic River, due to Housatonic's lower dissolved oxygen content than the Aspetuck, would produce the most electricity. The results showed that the Aspetuck River mud, on average, produced about 250 millivolts, the Housatonic River mud 100 millivolts and the control only 1.6 millivolts of output voltage over three trials. This shows that the effectiveness of bacteria in a MFC is more complex than simply a bacteria's electrochemical activity. Certain types of bacteria could contain special traits that make them superior or inferior to others in MFCs such as, creating biofilms around an electrode. This could the basis of a future experiment.

Biography

Jaden Williams is a Junior at New Milford High School. His project examines Microbial Fuel Cells which are a type of renewable energy resource that utilizes various forms of bacteria to create electricity by electromotive force. In his experiment, tests were conducted with bacteria from mud samples obtained from different sources. It was then determined how these sources affected the amount of electricity that the fuel cells produced. He attended his first science fair; Science Horizons, at Western Connecticut University in February. His project was the Overall Winner in the Senior Biological category.



Jaden has many interests; he is a part of a number of organizations and teams at his school including: the National Honor Society, Varsity soccer team, Math team, Key Club and many more. He is competitive and always challenges himself both in the classroom and on the sports field. He is undecided as to where he wants to go to college or what he would like to major in but his favorite subjects are math and science.