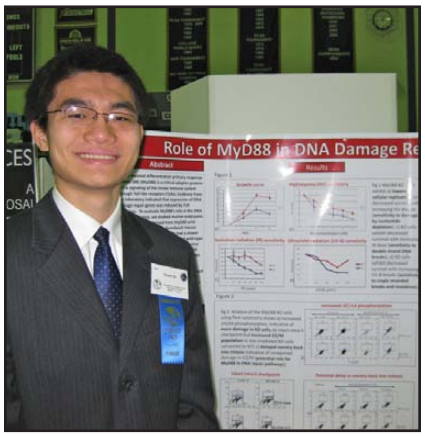
Meet Our Winners

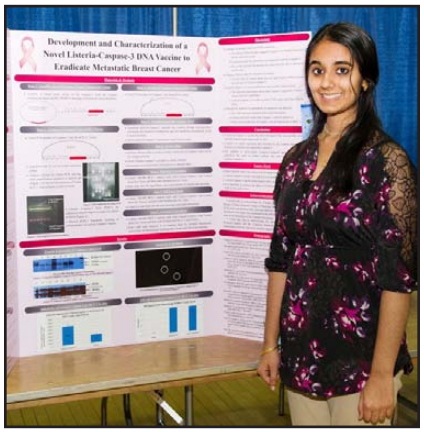
CONNECTICUT SCIENCE FAIR & SCIENCE HORIZONS
at the
INTEL INTERNATIONAL SCIENCE & ENGINEERING FAIR
Los Angeles, California, May 8 - 13

I-to-r: Toni Viola, Science Horizons; Shubhro Saha, CSF; Ryan Kerr, Science Horizons; Swathi Krishnan, CSF; Ryota Ishizuka, CSF; Amoolya Narayanan, CSF; and Yiyuan Hu, CSF

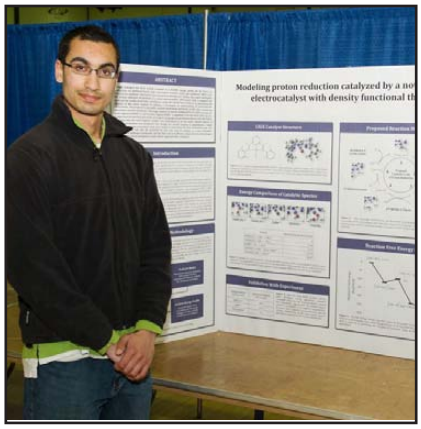
Ryan Kerr, Sophomore, Danbury HS
Winner, Science Horizons
1st Place Alexion Biotechnology



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



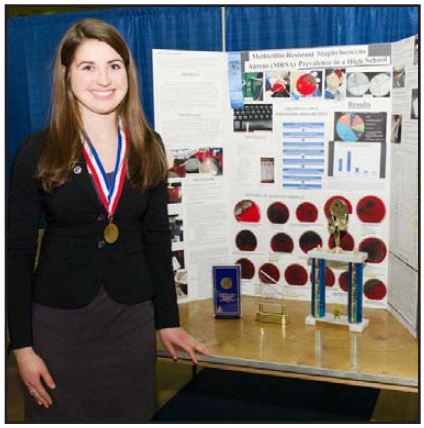
Swathi Krishnan, Senior, Rye Country Day School
1st Place, Pfizer Life Sciences



Shubhro Saha, Senior, Choate-Rosemary Hall
2nd Place, Dominion Physical Sciences

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

Amoolya Narayanan, Senior, Glastonbury HS
2nd Place, Alexion Biotechnology



Toni Viola, Junior, New Milford HS
Winner, Science Horizons

CONNECTICUT SCIENCE FAIR

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Trip Winner to the
Intel International Science and Engineering Fair
Los Angeles, CA, May 8 - 13, 2011

(Student information as of April 2011)

Ryota Ishizuka, Grade 11

Greenwich High School, Greenwich, CT

Project Title: Optimization of a Microbial Fuel Cell Structure to Drive a Bioelectrochemically-Assisted Wastewater Treatment Reactor

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
- Barnes Aerospace Applied Technology Awards --- 1st Place High School - $500 and Trophy, Medallion and lunch with intellectual property attorney
- CT Clean Energy Fund Alternative/Renewable Energy Awards --- 2nd Place High School - $300 Cash and Trophy
- eesmarts/CT Energy Efficiency Fund Future Sustainability Awards --- High School Finalist - Medallion and Acrylic Award
- United Technologies Corporation Awards --- $500 in UTC Common Stock, Plaque, Backpack 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

Abstract

Microbial Fuel Cells (MFCs) hold great promise in enhancing energy-intensive sewage treatment facilities, while simultaneously generating sustainable forms of energy. Such MFCs employ bacteria present in wastewater and manipulate natural bacterial process to convert biodegradable pollutants into electricity. Supplementing additional voltage (0.2V) may alternatively allow for the production of H2 in a Bioelectrochemically Assisted Microbial Reactor (BEAMR). This investigation first seeks to determine optimal conditions for MFC performance. Wastewater was sampled from three stages at the Stamford Water Pollution Control Authority plant: influent, biological reactor, and thickener underflow. The effectiveness of wastewater treatment was evaluated through the colorimetric determination of Chemical Oxygen Demand (COD). Pyrex cells served as the base for the single-chamber air cathode MFC; the electricity generated was measured with a data acquisition system. The MFC output and cost efficiency was thus maximized by employing varying electrode materials (SS mesh, carbon cloth, carbon mesh), Pt catalyst loadings, PTFE diffusion layers, buffer solutions, carbon support materials (vulcan carbon, carbon-nanotubes, graphene oxide), bacterial source (wastewater, C. saccharolyticus), and concentration. Scanning Electron Microscopy and Energy Dispersive X-Ray Spectroscopy determined the composition and bacteria present on such electrodes. A maximum voltage of 0.65V was ultimately generated, amounting to a 67% increase in production over cells constructed according to previous literature. COD removal efficiency increased as a function of voltage and indicated that 94.9 ±3% of organic material in the wastewater was removed. The successfully optimized MFC effectively powered a similarly optimized BEAMR in a fully autonomous system, producing 25% H2, as measured by thermal conductivity GC.

Biography

Ryota Ishizuka is a Junior at Greenwich High School participating in the Honors Science Research program for the first time this year. His research developed a fully autonomous system capable of generating electricity and hydrogen using only wastewater as a source of fuel. The system performance was ultimately optimized to facilitate practical applications of this technology. In the following weeks, he will be presenting his work at the International Sustainable World Project Olympiad (I-SWEEEP), in addition to ISEF. Ryota has been selected to attend the Research Science Institute (RSI) in the upcoming summer, an all-expense-paid six-week-long summer program held at MIT, where he will continue to conduct intensive science research. An active member of the school's state-winning math team, Ryota will individually be representing the state at the national math competition. He also competes for the school's varsity cross country, indoor and outdoor track teams. Ryota is currently looking into colleges and plans to major in applied math and engineering.

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(Student information as of April 2011)

Swathi Krishnan, Grade 12

Rye Country Day School, Rye, NY, CT

Project Title: Development and Characterization of a Novel Listeria-Caspase-3 DNA Vaccine to Eradicate Metastatic Breast Cancer

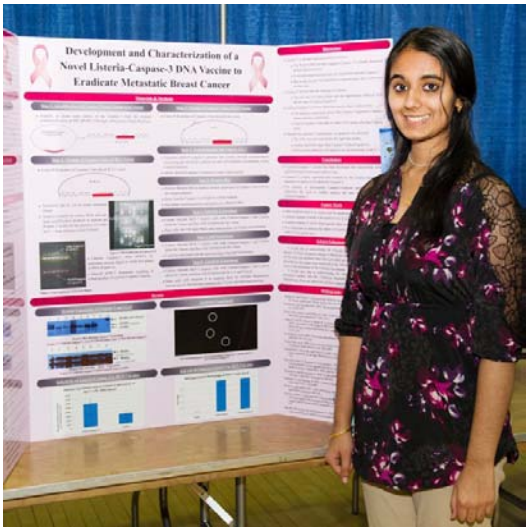
Connecticut Science Fair Awards

- Pfizer Life Sciences Awards --- 1st Place- Life Sciences Senior High- $500 & trophy, Trip to compete at Intel ISEF
- 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 --- Finalist - Biotechnology Senior High - CSF Medallion & Acrylic Award Souvenir
- Office of Naval Research- U.S. Navy / U.S. Marine Corps --- High School- Certificate, $75.00 gift certificate

Abstract

One of the main problems in cancer vaccination is the strong suppression of vaccine-induced immune responses in tumor environments, especially in patients 65 years and older, due to T cell unresponsiveness. The goal of this study was to develop and test an effective breast cancer vaccine to eradicate metastasis without inducing T cell responses. The developed vaccine is a combination of Caspase-3, an apoptotic enzyme, and the bacterium Listeria monocytogenes – an intracellular pathogen that can deliver vaccine antigens. Listeria-Caspase-3 kills tumor cells through different pathways: (1) tumor cell kill by Caspase-3 induced apoptosis, (2) tumor cell kill through Listeria-induced Reactive-Oxygen-Species, and (3) tumor cell kill by natural-killer cells. Using a two-step procedure, wild-type Caspase-3 was cloned into the Listeria bacterium, and then tested for its infectivity, kill capabilities, and ability to induce apoptosis in MCF-7, a human breast cancer tumor cell-line. The infection experiments give evidence that Listeria-Caspase-3 infected 133% more MCF-7 cells than Listeria alone. The kill experiments demonstrated that Listeria-Caspase-3 kills MCF-7 cells at a similar rate as Listeria alone, 97.2% and 97.9% respectively. The apoptosis assay, however, proved inconclusive. Although initial testing shows promising results, further testing is needed to understand the full capabilities of Listeria-Caspase-3.

Biography



Swathi Krishnan is a senior at Rye Country Day School. This is her fourth year competing at the Connecticut Science Fair. For the past two years, she has been working to create a vaccine that can eradicate breast cancer metastasis. She has successfully created the vaccine, which shows promising results in initial testing. In addition to winning first place in the Pfizer Life Sciences category at the 2011 CSF, she also won 2nd place at this year's Connecticut Junior Science and Humanities Symposium (JSHS), which allows her to present her research at the 49th National JSHS in San Diego, CA.

At her school, Swathi is Editor in Chief of both her school newspaper, *Crop*, and literary magazine, *Omega*. She is also president of the Science Club, founder of Dance Around the World, a club that explores different international dance styles, and a member of the Student Leadership Council. Swathi has learned Bharatanaytam, a form of Indian classical dance, and Carnatic, a form of Indian classical music, for the past 13 years. She has also explored the ancient language Sanskrit for the past three years, learning how to read, write, and converse fluently. Swathi hopes to pursue both Biology and Sanskrit at the University of Chicago.

SCIENCE HORIZONS SCIENCE FAIR

http://sciencehorizons.info/

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(Student information as of April 2011)

Ryan D. Kerr, Grade 10

Danbury High School, Danbury, CT

Project Title: Biological Control of Ticks to Prevent Lyme Disease Using Entomopathogenic Nematodes

Connecticut Science Fair Awards

- Pfizer Life Sciences Awards --- Finalist - Life Science Senior High - CSF Medallion & Acrylic Award
- Alexion Biotechnology Awards --- 1st Place- Biotechnology Senior High- Trip to compete at Intel ISEF, $500 & trophy,
- Milton Fisher Science Fair Award for Innovation and Creativity --- For Excellence in Creativity and Innovation by a High School student, $200 cash
- Science Horizons Senior High Awards --- 1st Place Senior High - $1,000 & All Expense Paid to Compete at Intel ISEF

Abstract

Lyme disease is a serious health concern in the U.S. with more than 30,000 reported cases each year. It is caused by the bite of a blacklegged tick infected by the Borrelia burgdorferi bacteria. Symptoms of this disease include neurological complication, arthritis and paralysis, and it is resistant to treatment in many instances. I measured the prevalence of B. burgdorferi infection to be as high as 92% using direct immunofluorescence microscopy. Presently, the only method to control tick populations is through environmentally harmful insecticides. These insecticides kill not only ticks, but other non-target species including mammals. In order to solve this problem, the feasibility of biological control was tested using entomopathogenic nematodes: naturally occurring microscopic roundworms. I tested the effectiveness of two different species on their ability to kill ticks over a 7 day period. Neither species were effective in killing normal adult ticks. However, both were effective in killing engorged adult females with an LD50 of 63/cm2. The nematodes were approximately half as effective against ticks compared to a positive control of mealworms (LD50 25/cm2). Since only engorged female ticks lay eggs, entomopathogenic nematodes can potentially be used on a large scale to decrease tick populations and prevent Lyme disease in an environmentally-sound manner

Biography

Ryan Kerr is a sophomore at Danbury High School in Danbury, CT. Ryan's project on developing a biological method for controlling tick populations to prevent Lyme disease using microscopic roundworms earned him fist place for both Biotechnology and in the Science Horizons fair competition. He also finished in 2nd place in the poster competition at the 2011 CT Junior Science and Humanities Symposium. This was Ryan's third year competing in the CSF where in 2009 he finished in first place for life sciences in the 8th grade Middle School division and in 2008 he finished in fourth place. At the 2009 Regional Science Horizons Fair Ryan was named the Overall Junior Division Winner, earning him a trip for two to Space Camp in Huntsville, Alabama. In school, Ryan is an honor student and a member of the high school math team. He also enjoys playing trumpet for the school marching band and jazz band as well as various summer bands. In addition to his academic and artistic pursuits, he also enjoys playing soccer for his high school team and on a local premier soccer club. Ryan likes the outdoors and is active in his local Boy Scout troop and is presently an Eagle Scout candidate. He enjoys relaxing by playing video games. Throughout high school, he hopes to be able to continue to pursue his wide range of interests in academics, sports, music, and community service.

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(Student information as of April 2011)

Yiyuan Hu, Grade 11

Hamden High School, Hamden, CT

Project Title: Role of MyD88 in DNA Damage Response

Connecticut Science Fair Awards

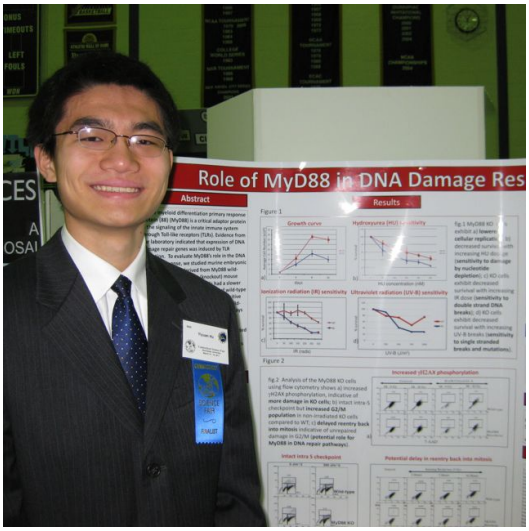
- Pfizer Life Sciences Awards --- 2nd Place- Life Sciences Senior High- $300 & trophy, Trip to compete at Intel ISEF

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. To evaluate MyD88's role in the DNA damage response, murine embryonic fibroblasts (MEFs) derived from MyD88 wild-type and MyD88-deficient (knockout) mouse embryos were studied. MyD88 knockout MEFs had less growth when compared to that of wild-type MEFs. Knockout cells 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. These results suggest an unexpected and novel role for MyD88 in the cellular response and repair of DNA damage. Current experiments include analyses of cell cycle checkpoints and elucidating the interactions between the innate immune and DNA damage responses through flow cytometry, immunoprecipitaion, and Western blot analyses.

Biography

Yiyuan Hu is a junior at Hamden High School; he is an avid painter, athlete, volunteer, and musician. He enjoys helping his community and aspires to become a doctor or a medical researcher. Yiyuan is currently conducting research on the adaptor protein MyD88 at Yale Medical School and has earned many accolades for his work including 1st place at the Connecticut Junior Science and Humanities Symposium and 2nd place at the Connecticut Science fair. He will represent Connecticut in both the National Junior Science and Humanities Symposium in San Diego and the International Science and Engineering Fair in Los Angeles later this spring.



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(Student information as of April 2011)

Shubhro Saha, Grade 12

Choate Rosemary Hall, Wallingford, CT

Project Title: Modeling proton reduction catalyzed by a novel nickel electrocatalyst with density functional theory

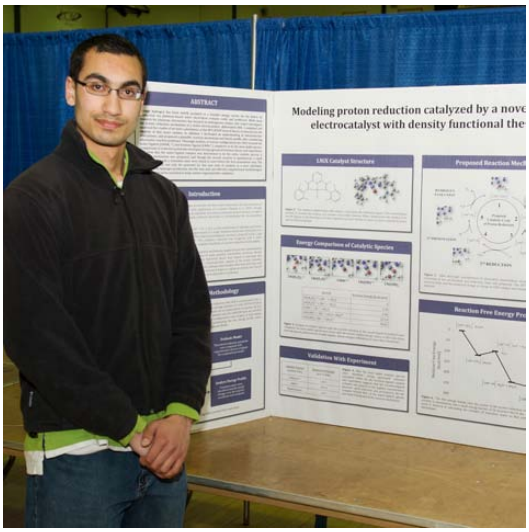
Connecticut Science Fair Awards

- Dominion's Millstone Power Station Physical Sciences Awards --- 2nd Place- Physical Sciences Senior High Individual - $300 & trophy, trip to compete at Intel ISEF

Abstract

Though hydrogen has been widely accepted as a feasible energy carrier for the future, its production via platinum-based water electrolysis remains costly and inefficient. While most research for platinum alternatives has focused on hydrogenase mimics, this report investigates the proton reduction mechanism of a nickel electrocatalyst, abbreviated LNiX. I computed and analyzed the results of ab-initio calculations at the DFT/B3LYP level of theory to characterize the identity of this novel catalyst. In addition, I developed an understanding of intermolecular interactions, and proposed a plausible reaction mechanism and kinetic profile after considering alternative reaction pathways. Thorough analysis of several configurations for LNiX revealed the water-ligated (LNiH2O+2) and bromine-ligated (LNiBr+1) complexes to be the most stable species. Comparison of reduction potentials developed strong agreement between theory and experiment, and from this the water-ligated complex was determined to be the active catalytic species. A reaction mechanism was proposed, and though the overall reaction is spontaneous, a small kinetic barrier was found to exist before the first protonation step. The findings advance not only the potential for this new class of catalysts as a more affordable alternative to hydrogen production, but the time and cost-efficient computational methodologies implemented can be extended to study similar organometallic complexes.

Biography



A resident of Avon, CT, Shubhro Saha always fostered a passion for science. In eighth grade, he was introduced to the field of hydrogen energy through a robotics competition. Then, during his sophomore year in high school, Shubhro embarked on a two-year research project that computationally modeled more efficient methods of hydrogen production by water electrolysis. Working at the Batista Group of Yale University, Shubhro helped to detail a plausible chemical reaction that would reduce the cost of this hydrogen production process.

Outside of research, Shubhro loves to debate, run cross country, and serve on the Student Council at his high school, Choate Rosemary Hall. He debated for Choate Debate Team for four years, serving as captain for the final two, and was a member of the team from the United States of America at the World Individual Debate & Public Speaking Championships in 2010 and 2011. On the Student Council, Shubhro served as President, and plans to deliver remarks at the Commencement for the Class of 2011. Shubhro also tutors students behind in reading and mathematics during the summer. Though he has not finalized his plans, he plans to study science and economics in college.

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(Student information as of April 2011)

Amoolya V. Narayanan, Grade 12

Glastonbury High School, Glastonbury, CT

Project Title: Anticancer property of major goat milk fatty acids and delineating their mechanisms of action

Connecticut Science Fair Awards

- Pfizer Life Sciences Awards --- Finalist - Life Science Senior High - CSF Medallion & Acrylic Award
- Alexion Biotechnology Awards --- 2nd Place- Biotechnology Senior High- $400 & trophy,

Abstract

Colorectal cancer, breast cancer and skin cancer are commonly reported cancer types in the US. Although radiations and chemotherapeutic drugs are routinely used to treat cancer, they produce harmful side effects in patients. Thus, there is a need for effective and safe molecules for preventing and treating cancers. The medicinal value of goat milk has been recognized for centuries, and is attributed to three fatty acids, namely capric, caprylic and caproic acids. This research investigated the anticancer property of these fatty acids on human colorectal, skin, mammary gland cancer cells. The cancer cells were treated with the fatty acids for 48 h and cell viability monitored by MTT assay. Additionally, the potential mechanism behind the anticancer property of three fatty acids was investigated using real-time quantitative PCR. Capric, caprylic and caproic acids reduced cell viability of three cancer types by 75 to 95% ($P < 0.05$) compared to controls. Gene expression studies indicated that these natural molecules produced their anticancer effect by down regulating cell cycle genes, and upregulating genes involved in apoptosis. Capric, caprylic, and caproic acids exerted significant inhibitory effect on cultured cancer cells, and future research will validate their anticancer effect in an appropriate in vivo model.

Biography

Amoolya Narayanan is a senior at Glastonbury High School. This is her fourth year of participation in the Connecticut Science and Engineering Fair. Her project this year investigated the anticancer properties of goat milk fatty acids on human breast, skin, and colon cancer cells. Her research in the previous two years investigated the potential trans-cinnamaldehyde, an ingredient in cinnamon, for controlling urinary tract infections. This research was published in two papers in the *Journal of Urology*, the official journal of American Urological Association. Amoolya won second place in the Biotechnology category at CSF this year, and will be competing at the Intel International Science and Engineering Fair (ISEF), Los Angeles, in early May. This will be her third year competing at ISEF. Amoolya is also an active member of her school's FIRST Robotics Team, Math Club and is the President of the India and South East Asia Club. Additionally, Amoolya choreographs and performs Bollywood and Classical Indian dance forms. She uses her dancing talent to volunteer for community and fundraising activities. For example, she is a cofounder of her school's InvASIAN club. As a leader of the club, she choreographs and teaches various Indian dances to other students in her school for performances throughout Connecticut. Last year, InvASIAN raised about $900 through their annual cultural program, which will be donated to build a well in a rural village in India. Amoolya also teaches and choreographs different Indian dance forms for small children for various community events.

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(Student information as of April 2011)

Toni Viola, Grade 11

New Milford High School, New Milford, CT

Project Title: Methicillin-Resistant Staphylococcus Aureus (MRSA) in a Suburban Connecticut High School

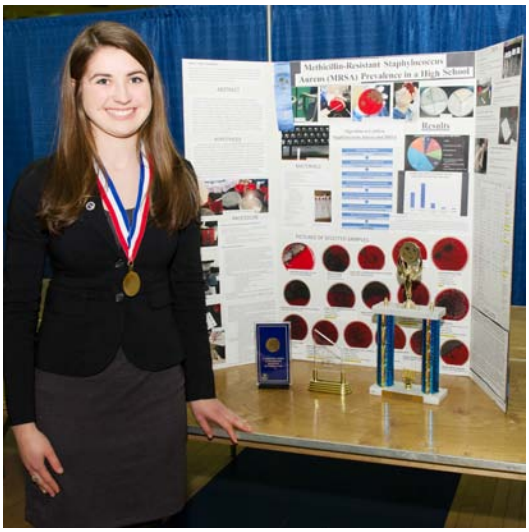
Connecticut Science Fair Awards

- Pfizer Life Sciences Awards --- Finalist - Life Science Senior High - CSF Medallion & Acrylic Award
- Alexion Biotechnology Awards --- 5th Place- Biotechnology Senior High- trophy
- Society for In Vitro Biology --- Certificate and membership to CT Science Center given by CSF
- Meyerand Young Woman Scientist Awards --- $300 cash - High School, Life Sciences
- Science Horizons Senior High Awards --- 1st Place Senior High - $1,000 & All Expense Paid to Compete at Intel ISEF

Abstract

In 2007 Governor Jodi Rell sent an advisory to Connecticut schools offering assistance and advice to prevent the spread of the potentially dangerous bacteria, Methicillin-Resistant Staphylococcus aureus (MRSA). This advisory was administered resultant of reported outbreaks in school facilities which led to student and athlete infection. The purpose of this experiment was to investigate the prevalence of Staphylococcus aureus, specifically MRSA, in a suburban Connecticut high school. Contributing factors to MRSA infection can potentially include a combination of improper hygiene/sanitation, and exposure. For these reasons, sample selection of cultures included commonly touched items, shared gym equipment, and objects that present difficult and/or infrequent cleaning procedures. A total of thirty samples were collected. The hypothesis of the experiment was that the samples would demonstrate selective positive results for MRSA, the extent of prevalence was however unknown. The samples were incubated on blood agar plates to investigate growth. Furthermore, a series of tests were necessary to identify the bacteria that did grow. These tests included a Gram stain, catalase test, coagulase test, and an oxacillin sensitivity test. The confirmation of MRSA was proven by its ability to grow in the presence of oxacillin as determined by measuring its zone of inhibition. The data concluded: out of thirty cultures, six were found to be Staphylococcus aureus, two of which tested positive for MRSA. This experiment demonstrates the presence of MRSA in a high school setting in areas that could potentially expose all students. Further investigations are suggested.

Biography



Toni Viola is a junior at New Milford High School. In her research, Toni investigated the prevalence of the dangerous bacteria, Methicillin-Resistant Staphylococcus aureus (MRSA). She collected thirty samples from commonly touched objects in the school setting including classroom doorknobs, handrails, and shared gym equipment. Toni is captain of the varsity swim team and she is frequently in school locker room environments, this among other factors, began to inspire her curiosity in the bacteria. She found MRSA in two locations-on a badminton racket and computer keyboard. Toni is preparing to apply to colleges in the fall, where she plans to major in biology. Along with swim team, Toni is also a member of the National Honor Society and Spanish Honor Society. In addition to her academics, Toni has a passion for dogs. She has been training Labrador Retrievers for Guiding Eyes for the Blind since fourth grade; three of her dogs are currently working guides. She actively gives demonstrations to local organizations such as the Lion's Club. To continue promotion of animal service, Toni founded her school's "Pet Club." Among her activities, Toni participates in triathlons and enjoys hiking, skiing, and playing piano.