CONNECTICUT SCIENCE FAIR

www.ctsciencefair.org

CSF Trip Winner to the Intel International Science and Engineering Fair, Albuquerque, NM, May 13 – 19, 2007

(Student information as of April 2007)

Russell L. Slater, Grade 11
Greenwich High School, Greenwich, CT

Project Title: Medicated Hydrophilic Wound Dressings

Connecticut Science Fair Awards

Pfizer Life Science Awards – 1st Place, Senior High, $500 and trophy
U.S. Army - $50 Savings Bond & Certificate
U.S. Air Force – Pad folio, thumb drive, PDA, pen and pencil set
Scientific American – Certificate and subscription to Scientific American

Abstract:

An innovative type of hydrophilic wound dressing has been developed that can the time release water and provide a sterile environment for a covered wound. In a non-sterile environment, these dressings will do nothing to curb or prevent the spread of bacterial infection. Research on the time release of anti-bacterial medication from these dressings has been limited. The purpose of this project was to successfully infuse I_2 into a wound dressing, and demonstrate that this dressing will time release adequate medication to kill and prevent the re-growth of E. coli. To create the dressings, Hydromed-G polyurethane, propylene glycol, distilled water, and iodine tincture were mixed together, heated, and finally ironed to make them workable. A circular medicated wound dressing with a radius of 17 mm was then placed upon a culture of E. coli, and it was later determined that a concentration of 3.75×10^{-6} moles I_2/g dressing would successfully kill E. coli with a 20 mm radius of the area of inhibition (extending 3 mm beyond the dressing) after 26 hours. A similar concentration of I_2 was embedded into a wound dressing, and a rate of elution experiment utilizing UV/Vis spectroscopy was developed. Analysis of the elution solutions from this experiment indicates that the optimal concentration of I_2 for inhibiting bacterial growth elutes out over a 24-hour period. It can be concluded that time-release antimicrobial wound dressings provide a sterile environment, successfully kill E. Coli bacteria within 26 hours, and release all of their medication within a 24 hour period.

Biography:

Russell Slater is a junior at Greenwich High School in Greenwich, CT. His current research project has been a work in progress for two years. He sees a lot of potential for future work in the same area. The recognition received as well as the opportunity to go to Intel ISEF this May to showcase his work and see other students' research are greatly appreciated. Russell is currently in the process of investigating universities for application in the fall. Despite his recent success in the area of medicine and health, he is undecided on a major area of study for his undergraduate work. Russell is interested in a variety of subjects including science, math, politics and law, and he plans to pursue a degree in Liberal Arts.

Russell's extracurricular activities include the Greenwich High School cross country running and tennis Varsity teams. He is also a leading (and award winning) member of the high school varsity Debate Team. Russell also believes in the importance of giving back to the community, and regularly tutors and mentors high school, middle school, and elementary school students.

CONNECTICUT SCIENCE FAIR

www.ctsciencefair.org

CSF Trip Winner to the Intel International Science and Engineering Fair, Albuquerque, NM, May 13 – 19, 2007

(Student information as of April 2007)

Elisabeth A. Baseman, Grade 12
Brewster High School, Brewster, NY

Project Title: EMMA: Determining the Effects of Environmental Disasters on Ecosystems
Design, Testing and Application of EMMA (Ecological Model for Management Analysis)

Connecticut Science Fair Awards

Pfizer Life Science Awards – 2nd Place, Senior High, $300 and trophy
Mu Alpha Theta – Certificate, $50 CSF gift certificate
Long Island Sound Foundation, Inc. - $500 U.S. Savings Bond for excellence in Environmental Studies
The Gagnon Award for Excellence in the Life Sciences - $100 cash award and certificate

Abstract:

Although the frequency and intensity of environmental disasters have been steadily increasing, specific data regarding effects of these disasters on ecosystems is rare. Organizations concerned with preservation of ecosystems in areas threatened by disasters need a way to qualitatively predict how their area will be affected and what management strategies are needed to conserve the ecosystem.

This study introduces EMMA (Ecological Model for Management Analysis), an original ecosystem model developed from Lotka-Volterra equations, including carrying capacity, Type II predator functional response and disaster simulation capabilities, as a discrete time simulation within Microsoft Excel. For qualitative stability analysis, the system is shifted to center on the origin and linearized. Eigenvalues are used as indicators of stability. Eigenvalue predictions are accurate in most cases, and carrying capacity is determined to be an important factor in ecosystem stability.

Analysis of EMMA implies a threshold value for carrying capacity, above which the ecosystem destabilizes. Continuing research includes determining this threshold.

General EMMA dynamics suggest that ecosystems threatened with a disaster that lowers carrying capacity (wildfires, drought, etc.) do not necessarily require management, as low carrying capacity can help to stabilize the ecosystem. However, management is needed if a disaster threatens to increase carrying capacity (floods for aquatic species, destruction of nearby city, etc.), because high carrying capacity can cause instability. Six hypothetical case studies demonstrating possible uses of EMMA are presented, including applications to nuclear waste disposal and city planning. Findings are confirmed by data obtained from researchers in the field.

Biography:

Elisabeth Baseman is a senior at Brewster High School in Brewster, NY and has been working on her independent science research since her freshman year. She is a member of the Science and Math Honor Societies as well as the National Honor Society. As a freshman, she was selected by her high school to attend the spring T.J. Watson Honors Mathematics and Science Lectures at IBM's T.J. Watson Research Center in Yorktown, NY. In addition to being an active participant in the sciences, she is heavily involved in her high school's performing arts department. She plays flute and piccolo, and toured Europe last summer with the Sound of America Honor Band. Although she has not yet made a final college selection, she plans to major in mathematics, with a possible double major in music performance.

CONNECTICUT SCIENCE FAIR

www.ctsciencefair.org

CSF Trip Winner to the Intel International Science and Engineering Fair, Albuquerque, NM, May 13 – 19, 2007

(Student information as of April 2007)

George J. Hansel, Grade 11
Greenwich High School, Greenwich, CT

Project Title: New Techniques in Fluorescence Microscopy

Connecticut Science Fair Awards

Connecticut Science Center Physical Science Awards – 1st Place, Senior High, $500 and trophy
The Coherent, Inc. Richard Hart Award for Excellence in Photonics - $300 cash, plaque, invitation to lunch and tour of the Coherent factory
Scientific American – Certificate and subscription to Scientific American

Abstract:

The phenomenon of autofluorescence, the tendency of pigments naturally within the sample to fluoresce, is generally considered 'noise' and is minimized to the greatest extent possible so that only targeted dyes are imaged. However, for certain organisms, autofluorescence may be exploited for imaging and spectral observations not otherwise possible, provided appropriate apparatus is used. In this research, a fluorescence microscope was constructed to be capable of both epi-illumination and hypo-illumination using gas and diode laser and LED light sources. The addition of a fiber-optic light spectrometer facilitated collection of spectral data at extremely small scales as well as the traditional image data. Hypo illumination by an argon-ion laser has enabled the imaging of chlorophyll and photosystem autofluorescence of organisms such as Euglena gracilis in vivo with high signal-to-noise ratios. With this apparatus, extremely dim chlorophyll autofluorescence was able to be seen with the naked eye through the microscope, and image data was easily collected with a conventional charge-coupled device. However, the distinguishing feature of the apparatus remains the ability to collect spectral data at high sensitivity with high signal-to-noise ratios on a microscopic scale of approximately 20 microns. Spectral data of extremely dim chlorophyll autofluorescence in vivo in the protist algae Euglena gracilis can be collected with signal-to-noise ratios exceeding 25 dB.

Biography:

I am currently a junior at Greenwich High School, in Greenwich, Connecticut. The characteristic of mine which I am most proud of that I am interested in everything. I am just as likely to be found peering through a microscope as translating Latin or ancient Greek lyric poetry. Though at this point my greatest accomplishment involves shining lasers at algae in an effort to cause them to fluoresce, I have a wide array of interests. My favorite activities involve working with my hands, doing something physically, and not necessarily sitting at a computer. To this effect, I enjoy tinkering with any item I can get my hands on, and am reputed for disassembling nonfunctional machinery. In addition to tinkering with machinery, I tinker with produce – cooking is a well-loved hobby. My favorite extracurricular, yet still school-sponsored activity is extemporaneous debate. Not only is it an excellent excuse to argue and reason and use critical thinking, but it is great practice for fielding questions from science fair judges. Other hobbies of mine include photography and building model airplanes. My favorite sport is undoubtedly Ultimate Frisbee, though sailing (in both summer and winter) and bicycling come in a close second.

CONNECTICUT SCIENCE FAIR

www.ctsciencefair.org

CSF Trip Winner to the Intel International Science and Engineering Fair, Albuquerque, NM, May 13 – 19, 2007

(Student information as of April 2007)

Dayton T. Horvath, Grade 11
Newtown High School, Sandy Hook, CT

Project Title: A Novel, Rapid, Inexpensive Coliform Detection System

Connecticut Science Fair Awards

Connecticut Science Center Physical Science Award – 2nd Place, Senior High, $300 and trophy
Barnes Aerospace Applied Technology Awards – 1st Place High School - $500 and trophy
Boehringer Ingelheim Parmaceuticals, Inc - $1000 Chemistry
Institute of Food Technologists, Nutmeg Section - $100 award + subscription + invitation to meeting
Long Island Sound Foundation, Inc. - $500 U.S. Savings Bond for Excellence in Microbiology
ISA – The Instrumentation, Systems and Automation Society – 2nd Place, $75 award
The Stanley Lessoff Award for Excellence in Analytical Technique - $200 cash and plaque

Abstract:

The presence of a harmful strain of *Escherichia coli* in various foods has led to ample news coverage of incidents where people have become ill from contaminated foods. Standard methods for detecting *E.coli O157:H7* involve culturing the bacteria over a twenty-four hour period for verification of its presence. A rapid method for bacterial detection has been developed using a GFP-labeled lysozyme-inactivated T4 bacteriophage, which infects *E.coli* cells and transfers the Green Fluorescent Protein (GFP) gene into the bacterial genome. Expression of GFP indicates the presence of *E.coli*. The typical method to identify the presence of GFP involves using a fluorescence microscope, which is expensive and not common in an environmental or food safety lab. A specialized fluorimeter was developed to suit the specifications of a novel, inexpensive detection system using the GFP-bacteriophage technology. The excitation required for the detection of the GFP-enhanced *E.coli* was determined to be 395 nanometers hence an inexpensive UV-LED in conjunction with a silicon photodiode was used. The simplicity, cost, and practicality of the device were strongly considered during design. The time for a detection result was greatly reduced from a day to a couple of hours, because of the rapid adsorption of the phage and subsequent expression of the GFP in *E.coli.* The primary function of the detection method (using the phage and the device) is for a preliminary field test to determine the presence of *E.coli.* The optimized method and design of the device may help future applications in the detection of harmful pathogens.

Biography:

Dayton Horvath is a junior at Newtown High School currently taking challenging courses and participating in the Senior Project Program. He joined the class to showcase his science research project in addition to regional science fairs. He was motivated to create a project this year based on his varied interests in physics, optics, chemistry, and independent research. Besides his interest in science, Dayton plays soccer throughout the year with the Newtown High School JV soccer team and with Samba TTP, a premiere team based in Newtown, CT. If he is not tutoring or doing homework afterschool, he is outside hiking and doing hands on work. After high school, he hopes to go into a career in physical science or engineering.

CONNECTICUT SCIENCE FAIR

www.ctsciencefair.org

Science Horizons Trip Winner to the Intel International Science and Engineering Fair, Albuquerque, NM, May 13 – 19, 2007

(Student information as of April 2007)

Alexandra L. McIe, Grade 11
Brewster High School, Brewster, NY

Project Title: Integrating Hirudin from Hirudo into an Anticoagulative Medication for Equus Caballus

Connecticut Science Fair Awards

Pfizer Life Sciences Awards – Finalist, Senior High, CSF Medallion & Acrylic Award Souvenir
The Otero Family Award - $150 cash award

Abstract:

The protein hirudin acts as an anticoagulant and mild anesthetic. It is secreted in the saliva of Hirudo medicinalis, the medicinal leech, while feeding to act as a thrombin inhibitor in its prey. Although already commonly used for humans, this study investigates the possibilities of hirudin's pharmaceutical usages for Equus caballus, the domestic horse. Four specific areas of the study have been outlined; collection of the hirudin sample, purification, mass production, and delivery method to Equus caballus. The first two were the main focus of this phase of the study. A saliva sample was successfully taken from the medicinal leech. The protein within it was then purified through column and thin layer chromatography. Beaded and powdered silica gel and sol-gel were compared for effectiveness as the column. Also tested were silica gel, alumina and paper chromatography plates, as well as two different solvents; ethanol and methanol. Results from the thin layer chromatography confirm the extent to which the column purified the sample by showing the ranges of mass and density in the remaining particles. Through this system, a sol-gel column was the most effective purifier, and silica gel chromatography plates provided the clearest means by which to visualize results. There was no significant difference between solvents. Plans for future research include plasmid transformations into multiple strains of E. coli, and testing a method by which to administer the medication. Possible methods have already been designed for trial.

Biography:

Alexandra McIe is currently in her junior year at Brewster High School. This is her second time as a finalist at the Intel ISEF with her research in the field of veterinary medicine. Most recently, she has been working toward developing a medication for the domestic horse from an enzyme secreted by the medicinal leech. At school, Alex is a member of the Science Honor Society. She also plays flute and piccolo in her school's wind ensemble, Putnam symphony orchestra, and school musicals. This past summer, she traveled with the Sound of America honor band through Europe. She plays on the tennis team, is a captain of the varsity ski team, and is an editor of the school newspaper. In her remaining free time, Alex can be found horseback riding at the barn, reading Dante, or watching British comedy.