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Intel International Science and Engineering Fair (ISEF)

USAID Science for Development Award

2017 Winners

11 Young Scientists

$20,000 in awards

Brilliant **solutions** for development

USA Brazil India Kenya

USAID
FROM THE AMERICAN PEOPLE

2017 ISEF USAID Science for Development Awards at a Glance

1st Place Winners

Sahithi Pingali, India
An Innovative Crowdsourcing Approach to Monitoring Freshwater Bodies

Lori Zhang, USA
Refining a Novel Device to Decrease the Risk of Vesicovaginal and Rectovaginal Fistula during Labor

Manashree Padiyath, USA
Unleading the Way! Remediation of Lead Contaminated Water with Coriandrum sativum (Cilantro) Biochar

Beatriz da Costa Dantas & Marcelo de Melo Ramalho, Brazil
Corn Cob Particleboard: Ecological Product Manufactured with Corn Cob and Husk Residue

2nd Place Winners

Bilhah Ontirah & Mitesha Varsani, Kenya
A Composite Material Made from Wastes of Glass, Polymers and Industrial Rubber as a Waste Management Initiative in Urban and Sub-Urban Areas in Kenya

Swathi Srinivasan, USA
A Novel High-Efficiency System for Infant Warming through Secondary Heating Mechanisms

Everett Kroll, USA
3D Printable Transtibial Prosthetic

Siva Bharathi Anbu Barathi & Ramkumaar Ekambaram Thondaiman, India
Innovative Method of Raising Paddy Seedlings by an Economically Viable and Ecologically Sustainable Method: A Boon to Farmers

Please note that abstracts are written by the pre-college student of the winning project and to preserve the integrity of their work, the language has not been modified.

First Place Winners

USAID
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Intel International Science and Engineering Fair (ISEF) Winners
USAID Science for Development Award

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Winning Abstract

Sahithi Pingali

India

An Innovative Crowdsourcing Approach to Monitoring Freshwater Bodies

Abstract: Freshwater pollution is a major environmental threat across the globe, exacerbated by the lack of ongoing scientific data about health of freshwater bodies. One way to address this problem is to crowdsource monitoring of freshwater bodies to interested citizens. To enable this I developed an integrated mobile phone app and a highly cost-effective monitoring kit consisting of an electronic sensing device and chemical test strips. The Arduino microcontroller based electronic device measures total dissolved solids, electrical conductivity, salinity, dissolved oxygen, and temperature of a water sample, and transmits this data to a mobile app via Bluetooth. The app also measures levels of pH, Hardness, Alkalinity, total Chlorine, total Bromine, free Chlorine, Iron, Copper, Phosphates, Nitrates, and Nitrites using a novel mobile camera based color detection and contaminant mapping method that avoids human subjectivity in detecting color changes in chemical test strips. The mobile app geo-tags and uploads all collected data to a global cloud platform that enables interactive monitoring, selection, and visualization of fresh water bodies using maps, time periods of interest, or contamination levels. The platform also classifies the overall health of a water body, determines usability of water for various purposes, compares detected contaminant levels against permissible limits, generates recommended actions for a polluted water body based on monitored parameters, and tracks water conditions before and after specific actions. Crowdsourced data from school children who monitored ten lakes over several months, along with accuracy tests, showed that this end-to-end monitoring system indeed provides reliable data and valuable insights on changing conditions of freshwater bodies.

Winning Abstract

Lori Zhang

USA

Refining a Novel Device to Decrease the Risk of Vesicovaginal and Rectovaginal Fistula during Labor

Abstract: In developing areas where professional medical care is scarce, the labor complications that result in the development of obstetric fistulae are common and the effects devastating, with over two million women currently suffering from severe incontinence, shame, and terrible pain. The purpose of this experiment was to refine and redesign a cost-effective and portable device to decrease the risk of vesicovaginal and rectovaginal fistulae during childbirth. From the use of an improved precise, self-built CAD and FEA model of female pelvic anatomy from anonymized CT scan data and both a mechanical simulation and computational fluid dynamics simulation program, different designs and design materials were tested, yielding a final device design. Then, the stress-distributing properties as well as the amount of strain experienced of the final design was compared with that of using no device at all. For the revised prototype, the mean stress at the key point showed a percent difference of almost 200% for all three tests, and each t-test performed for each test yielded a p-value much less than the declared alpha value of 0.05, showing that the device significantly decreases the amount of stress at points where fistulae commonly occur. A more complex model with isolated contact pairs and mathematical modeling, simulation, and inclusion of fluid factors contributed to the improved accuracy of the results and design. However, this design and the model will be further optimized with daily redesigning and simulation.

Winning Abstract

Manashree Padiyath

USA

Unleading the Way! Remediation of Lead Contaminated Water with Coriandrum sativum (Cilantro) Biochar

Abstract: Due to the recent Flint Water Crisis, much attention has been directed again towards the presence of heavy metals in water and its health and environmental implications. There also remains a continued need for inexpensive techniques for filtering out heavy metals from contaminated water in many third-world countries. There is evidence to suggest that herbs such as Coriandrum Sativum (cilantro) can act as bio-sorbents and remove lead and other toxic metals from water. There have also been several studies showing efficacy of biochar (pyrolyzed organic matter) for heavy metal removal. The purpose of this research was to assess the effectiveness of biochar, made from cilantro, for remediating lead contaminated water. It was hypothesized that the cilantro biochar, with its high surface area and porosity, will be more effective in reduction of lead content compared to cilantro leaves. The effectiveness of lead removal from a 1 ppm lead solution was studied for cilantro leaves, cilantro biochar, bamboo biochar, and commercial BritaTM filter material. The amount of lead was quantified using ICP Spectroscopy. Samples were taken at multiple time intervals. Results showed that at 2 hours the Cilantro leaves reduced the lead content only by 3.8%, while Bamboo biochar, BritaTM and Cilantro biochar were able to decrease the lead content by 54.8%, 74.1% and 99.9% respectively. Cilantro biochar was able to reduce the lead content to undetectable levels in 30 minutes. These findings are very important for the development of a more cost effective means for lead removal from contaminated drinking water.

Winning Abstract

Beatriz da Costa Dantas & Marcelo de Melo Ramalho

Brazil

Corn Cob Particleboard: Ecological Product Manufactured with Corn Cob and Husk Residue

Abstract: Corn is the world's largest cereal crop with approximately 960 million tons produced last season. Brazil produces 82 million tons and is the third largest producer in the world. However, 18% of this production is composed of husk and cob, materials considered waste that are usually burned, generating air pollution. The goal of this project was to propose an economical and environmental viable alternative by developing a particleboard produced with maize production residue. The new product named CCP (Corn Cob Particleboard) was produced by mixing, in different proportions, cob particles, corn husks and thermoplastic synthetic adhesive and by applying cold manual pressing. The board was kept in a mold during different air drying periods. The first produced panels were composed by the husk/cob ratio of 1:4 and 400 ml of adhesive and were then dried for 48 hours. Those panels did not present the desired physical properties and were not submitted for further testing. A second batch of CPPs panels was produced with husk/cob ratio of 1:2 and 100 ml of adhesive, and then dried for 2 hours. The boards formed with this composition had their physical and mechanical properties evaluated and were compared to other commercial engineered wood boards. CPP boards presented linear expansion and thickness swelling values similar to MDF (Medium-Density Fiberboard) and MDP (Medium Density Particleboard) boards, demonstrating good dimensional stability. The mechanical strength of the CCP was higher than the commercial MDF, being able to withstand a higher applied load. The CCP has proven to be a potential new, technically viable product with low production cost. It is environmental friendly, since it uses waste from agricultural production and reduces the demand for wood.

Second Place Winners

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Intel International Science and Engineering Fair (ISEF) Winners
USAID Science for Development Award

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Winning Abstract

Bilhah Ontirah & Mitesha Varsani

Kenya

A Composite Material Made from Wastes of Glass, Polymers and Industrial Rubber as a Waste Management Initiative in Urban and Sub-Urban Areas in Kenya

Abstract: This project explores how wastes of glass, rubber and plastic polymers can be combined together to obtain a composite material that is resistant to squeezing, tearing or fragility. Wastes, such as plastic, glass & rubber make up about 65% of wastes in urban and suburban areas in Kenya. The wastes were collected, cut, shredded & ground. The polymer and rubber pieces were heated and melted mixture combined with the cullet (crushed glass); this was done in different ratios of 3:1:2, 3:2:2 and 3:2:1 with the exception of the general sample containing a ratio of 1:1:1. Preceding cooling, it was then poured into metallic molds of different shapes & sizes suitable for the type of test that will be performed. After forty-five minutes of cooling at 25°c, the plastic was removed. The samples of different shapes were then subjected to different tests i.e. tensile test, compressive test, flexural test, impact test and coefficient of friction test. The ratio of plastic to glass to rubber of 3:1:2 gave us a material that is resistant to squeezing, tearing or fragility. This study showed that only certain ratios of the materials could be used to produce a durable long lasting. In our research, we concluded that the composite we made using wastes of plastic, glass and rubber had the properties of an efficient infrastructural material which could be used as a waste management initiative in urban and suburban Kenya.

Winning Abstract

Swathi Srinivasan

USA

A Novel High-Efficiency System for Infant Warming through Secondary Heating Mechanisms

Abstract: Each year, 15 million infants—one in every ten born worldwide—are susceptible to hypothermia. This makes thermal stability a necessity for infant survival, with negligence of a stable environment potentially leading to neurological complications and death. Yet, current methods to target infant hypothermia are inadequate; high-power transport incubators are expensive ($50,000-$150,000) and use forced-air heating, while warmers using less-expensive phase change materials can only supply heat for less than four hours. To create a portable, inexpensive, energy-efficient, reusable infant warming device, a two-dimensional, multi-power heating grid was embedded into a sodium acetate gel pack. The resistive heating-based grid was then powered by two rechargeable car batteries (12-volts each), and was prototyped to ensure consistent enthalpy change throughout each use. The developed warming mechanism used high and low power settings, operating at two separate equivalent resistances, to reach the optimal body temperature and then maintain that temperature. At steady-state, the warming device maintained consistent temperatures between 40-50˚C for over 30 hours as measured by a hand-held, infrared thermometer, thus outlasting the leading, low-cost infant warmer on the market, eight-fold. The implementation of embedded temperature sensors and temperature-based thermal cutouts in strategic locations, as well as in-line fuses, are works in progress intended to improve sensing and feedback, so as to prevent localized hot-spots and preserve infant, operator, and device safety. Overall, this inexpensive, reusable, portable, energy-efficient device is well-suited for ameliorating infant mortality, by warming the millions of at-risk infants facing moderate and severe hypothermia worldwide.

Winning Abstract

Everett Kroll

USA

3D Printable Transtibial Prosthetic

Abstract: Amputations affect over 1 million people worldwide each year. War and disease take a toll from too many who can hardly afford to pay. The goal of this project is to design and build a cost effective 3D printable transtibial prosthesis that functions as capably as mainstream prostheses standardly available in developed countries. 3D printing allows for prostheses to be easily scaled, redesigned and reprinted as needed, by replacing expensive materials such as metals and circuits with 3D printable polymers instead. Polymer research identified key chemical and mechanical properties necessary for a durable prosthetic. Polycarbonate, Polystyrene and Polypropylene were identified as having the optimal balance of elasticity, structural integrity and strength required for the prosthesis. Researching ankle and foot movement; combined with the study of gait analysis; allowed for an understanding of how various bones, ligaments, tendons and muscles work together, to enable walking; so they could be mirrored in the 3D printable design. Key physics concepts, including center of mass, moment of inertia, and Young's modulus were also incorporated into the prosthesis development. Other details, such as improved grip and a split toe shank base plate, ensure all manner of standard walking can be accommodated. The estimated cost will be less than $100, substantially more affordable than the $18,000 average cost of a transtibial prosthetic. The result is an affordable, highly versatile and aesthetically appealing transtibial prosthetic, capable of restoring the fundamental human function of comfortably walking for millions of transtibial amputees in developing countries.

Winning Abstract

Siva Bharathi Anbu Barathi & Ramkumaar Ekambaram Thondaiman

India

Innovative Method of Raising Paddy Seedlings by an Economically Viable and Ecologically Sustainable Method: A Boon to Farmers

Abstract: The farmers in the rice production area across India and Asia are very much dejected over the condition of agriculture because of the issues like poor rainfall and labor availability, which are causing the downfall of agriculture. The farmers are following the mechanized and manual rice cultivation and raising the seedlings for the rice cultivation is a big issue. Currently the farmers are using 100% soil from the field and raise the seedlings which are not healthy and takes long time (25 to 30 days) for them to get transplanted in the main field. The innovative media contains 50% of Coconut coir, 30% of pressmud from Sugarcane industry and 20% of rice husk (percent by volume), which gives high quality seedlings. The rice seedlings produced by this method takes all required nutrients for its growth from the three added components. It takes only 14 days for the seedlings to get ready for transplanting. In the new media, the seedlings need to be watered only once a day and 4.5 times lesser than the current farmer practice. It can be raised in the backyard or on the rooftop and the weight of one innovative seedling mat is 50% lesser in weight than the current farmer seedling mat. It can be easily rolled up for easy transportation and the media is biodegradable. The cost of the new media is 33% lesser than the farmers current practice per hectare. This media will be a boon to the rice farmers across the world.