

16 May 2011

OUTSTANDING PERFORMANCE BY SINGAPORE STUDENTS AT THE INTEL INTERNATIONAL SCIENCE AND ENGINEERING FAIR (ISEF) 2011

1. The Ministry of Education (MOE) and the Agency for Science and Technology (A*STAR) congratulate the Singapore students on their outstanding achievement at the Intel International Science and Engineering Fair 2011 (ISEF) held in Los Angeles, United States from 8-13 May 2011. The Singapore Team submitted two individual projects and one team project, all of which clinched awards at the ISEF.

2. The students and their winning projects are as follows:

- a) Cheng Heng Yi from NUS High School of Mathematics and Science won the First Award in the category of Computer Science for his project titled *Composing Frusta to Fold Polyhedral Origami*, under the supervision of his school teacher mentor, Mr Cheong Kang Hao. He received a cash prize of US\$3,000. Heng Yi also won two Special Awards; a 2nd Award of cash prize US\$500 from the Association for Computing Machinery, and a 2nd Award of cash prize US\$150 from the U.S. Patent and Trademark Office Society.
- b) Tan Yuan Jin from Raffles Institution won the Second Award in the category of Microbiology for *identifying and characterizing the bacterial endophytes suitable for its role as novel bio-inoculants for Jatropha*, a plant identified to be a good source of biodiesel. He received a cash prize of US\$1,500. As part of a research attachment programme, he conducted this research under the supervision of Dr Ji Liang Hui and Dr Madhaiyan Munusamy from the Temasek Life Sciences Laboratory.
- c) Team finalists comprising Matthew Lee Wei Liang and Ng Qin Xiang from Anglo-Chinese School (Independent) won the Second Award in the Environmental Management category for *investigating the adsorption potential of orange peel as a biosorbent for the removal of copper (II) ions* which is a potential heavy metal pollutant released into the environment. They received a cash prize of US\$1,500. A self initiated school-based project which started as a research component for the International Baccalaureate Diploma Programme, both students worked on the project under the supervision of their teachers, Mrs Evelyn Tan Tham Kwee, Mr Goh Yan Yih and Mr Heng Joo Cheng Merlvyn.

3. The Singapore Team was led by Mr Alfred Loo, Curriculum Planning Officer, MOE and accompanied by Dr Wulf Hofbauer, Senior Research Engineer at the Institute of Materials and Research Engineering and a judge for the Singapore Science and Engineering Fair (SSEF) since 2006.

4. This year saw an accompanying teacher mentor, Mr Cheong Kang Hao, from the NUS High School of Mathematics and Science, winning a Special Award from the Agilent Technologies Teacher Science Development Award. He received a cash prize of US\$5,000. Mr Cheong was nominated by Heng Yi to a selection panel at the ISEF to show his appreciation to his teacher for his guidance and encouragement throughout his project.

(See Annex for experiences of the award winners.)

Background Information of ISEF and SSEF

5. The ISEF, the world's largest pre-college science fair, is held in the United States annually and provides an opportunity for students from different parts of the world to showcase their science projects. ISEF is often regarded as the "Olympics" of science competitions. Over 1,500 finalists selected from 443 affiliated fairs in 65 countries, regions and territories from the US participated in the ISEF this year. Two individual projects and one team project from each affiliated fair are selected to compete at the international level. About 1,200 judges from different fields of science, engineering, and industry professionals are involved in judging the projects and selecting the winners.

6. In April this year, the students who represented Singapore at ISEF won top honours in the Singapore Science and Engineering Fair (SSEF), a local fair affiliated to ISEF. SSEF is a national competition jointly organised by MOE, A*STAR and Science Centre Singapore. The winners of SSEF are also eligible to participate in A*STAR Talent Search (A*TS)¹. At A*TS on 29 April 2011, Heng Yi clinched the First Prize award of S\$5000 cash and a sponsored trip to an overseas conference for his project.

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¹ A*TS is part of A*STAR Graduate Academy's youth science outreach to schools with the aim to inspire and sustain a passion in science in the young in Singapore. To participate in A*TS, the participants must be award winners of SSEF.

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The Thoughts and Experiences of the Winners

1. Cheng Heng Yi (NUS High School of Mathematics and Science)

My interest in origami stem from my passion in Mathematics and my desire to understand the geometry behind the origami models.

Many years ago, I folded an origami of the Eiffel Tower, part of which included folding a cube that rose out from the paper. My curiosity made me play around with the model, and I managed to change the folding instructions to fold cuboids of all sizes. Over the years, I tinkered with the models and managed to derive algorithms to fold even more complex shapes. These, coupled with my encounter with Mitani's algorithm, a Japanese researcher who presented an algorithm during the International Conference on Origami in Science, Mathematics and Education, led me to embark on this project.

When I derived the initial algorithm in my project, it did not work in many instances, so I persevered. Through detailed analysis into the failed algorithms, I eventually discovered a simpler yet better algorithm, which is what my project entails today.

All these would not have happened if not for my teacher mentor, Mr Cheong Kang Hao, who had encouraged me to pursue my interest. He has been most inspirational; guiding and supporting me in my research project. He is always accessible, making time to meet me for project discussions. His critical questioning often encourages me to ponder over my project details. Mr Cheong's great dedication and knowledge competency is truly remarkable. To show my appreciation for his guidance and encouragement, I nominated him for the Agilent Technologies Teacher Science Development award.

2. Tan Yuan Jin (Raffles Institution)

The idea of using nitrogen-fixing bacterial endophytes was from my Principal Investigator, Dr Ji Liang Hui, and my mentor, Dr Munusamy Madhaiyan, both from the Temasek Life Sciences Laboratory. Both of them allowed me to use my own ideas in revising the experimental protocol and proposing future research areas.

The project started off as a preliminary study to identify nitrogen-fixing bacterial endophytes as candidates for bio-fertilizers. However, throughout the course of the project, I discovered that some of the bacterial strains screened had the potential to benefit plant growth in ways other than nitrogen-fixation. As such, I began looking at the potential extensions of the project that could investigate other means through which bacteria can act as bio-fertilizers.

When the results were inconsistent and inaccurate, I persevered by constantly looking at ways to optimize and improve the protocol for the experiments. For example, one of my experiments returned negative results for almost all the bacteria tested. I then conducted a pilot study to determine if there was a problem with the recommended protocol and subsequently optimized my procedure with the knowledge gained from this pilot study.

When the results showed a trend that deviated from my expected results, I thought long and hard to formulate an alternative hypothesis to account for the unexpected trends. As a result, I have gained much scientific knowledge in the field of microbiology, in particular, the area of plant-microbe interactions and I also gained insights into the entire research process, picking up useful experimental skills and practical knowledge from working in a research lab.

3. Matthew Lee Wei Liang and Ng Qin Xiang [Anglo-Chinese School (Independent)]

The idea for the project started during a school trip to Phnom Penh, Cambodia last year. We observed that the lack of clean (or safe) drinking water was a serious issue. In Singapore, we are really fortunate that our tap water is potable, but current filtration systems are robust and highly expensive. Hence, we were motivated to investigate alternative water treatment methods that were low-cost yet effective for developing countries.

Our project is entirely self-initiated. Qin Xiang was the one who thought of the idea. We embarked on extensive independent reading of previous studies on adsorption. Without much experience, we worked out the actual project methodology ourselves using a rough framework derived from previous studies presented in research journals. Through much trial and error, we fine-tuned the important and intricate details and corrected them during the experimental phase itself.

The process of working through all the problems and troubleshooting the experimental conditions was time-consuming and required a lot of patience. However, working with a clear idea of the flow and scale of the project allowed us to persevere and see the project to completion. This was also made possible with the support of our school teachers and the senior administration.

In the course of this project, we have come to a clearer understanding of the scientific process and the expectations of a researcher. The experience of honing the project and conducting successive rounds of experimentation has sharpened our scientific thinking and led us to a clearer picture of what good research is and how it should be applied to real life situations. Not only have our laboratory techniques improved, we also have a clearer idea of the scientific methodology.

The novelty of our study stems from our holistic investigation to refine the effectiveness of orange peel biosorbents and environmentally friendly post-processing methods, in particular, bacterial desorption. Previous studies focused mainly on the removal of heavy metal ions using adsorbents but neglected the post-processing of the spent adsorbents.

This project has truly been an experience on the diversity of science and the many opportunities it can afford for exploration. Despite the many challenges, this journey has opened our eyes to the myriad possibilities in environmental chemistry research, fuelling our interest in research and development.

4. **Cheong Kang Hao** (Teacher, NUS High School of Mathematics and Science)

To me, it is a joy to mentor students in research projects because this is really my passion - to spur students on to tackle problems and solve “puzzles”. It gives me this immense enjoyment and happiness when I guide the students in this inquiry-based journey. During this journey, I not only emphasize the development of Mathematical research skills in them, but also encourage good habits of mind in them too. I believe Mathematics and the Sciences are imperative for innovation and I have been active in mentoring students in research projects for the past few years. I have also taken up the role of a Mathematics Project Coordinator in my school, prior to my current appointment as the Level Head in Affective Character Education.