NUS SATELLITES MAKE HISTORY IN SPACE

FIVE ENGINEERING RESEARCHERS are on the Thomson Reuters’ 2015 list

Doubling shelf life of perishable food with ECO-FRIENDLY PACKAGING FILM

Prominent Engineering researchers RETURNING HOME TO JOIN NUS
Both satellites are flying 550 kilometres above the Earth, on an orbital plane that has an inclination of about 15 degrees.

Galassia, a two-kilogramme nanosatellite, was developed by students and researchers from the Faculty of Engineering; Centre for Remote Imaging, Sensing & Processing (CRISP); and Centre for Quantum Technologies (CQT). It was developed by a team of 30 final-year engineering students pursuing the Satellite Design track under the Design-Centric Programme (DCP), together with six research engineers over a period of four years, beginning in 2012.

The Galassia project brings together students from various engineering disciplines to apply what they have learnt in a real-life setting, and challenges them to innovate and push boundaries. The successful launch of Galassia is a strong endorsement of NUS’ space engineering education and we hope that this will also inspire more talented students who are passionate about space R&D to pursue their interest in this field.

Kent Ridge 1, on the other hand, is a 77.2-kilogramme microsatellite jointly developed by the Department of Electrical & Computer Engineering and CRISP, together with partners which include Berlin Space Technologies, Nanyang Polytechnic and ST Electronics (Satcom and Sensors Systems) Private Limited. This hyper-spectral imaging micro-satellite is designed to conduct scientific experimentation and analysis of the earth’s surface. Kent Ridge 1 has an operational mission life of two years; it is much smaller and lighter than its conventional counterparts.

Not resting on their laurels, NUS faculty and researchers are already planning to develop a second generation Galassia and Kent Ridge 2, with the aim of achieving new technological breakthroughs with these projects.

The follow-on project for Galassia would involve the development of a six-unit nanosatellite with enhanced capabilities such as propulsion and attitude control together with an optical mission for high resolution imaging. The propulsion feature being considered has the potential to undertake an interplanetary mission, such as flying a nanosatellite to explore the moon. As for Kent Ridge 2, the NUS team would explore incorporating high resolution multi-spectral imaging.

Professor Goh Cher Hiang, Project Director of the NUS Satellite Programme at NUS Engineering, said, “The Galassia project brings together students from various engineering disciplines to apply what they have learnt in a real-life setting, and challenges them to innovate and push boundaries. The successful launch of Galassia is a strong endorsement of NUS’ space engineering education and we hope that this will also inspire more talented students who are passionate about space R&D to pursue their interest in this field.”
Prestigious AIMEE Engineering honours NUS professors

PROFESSORS James Goh and Lim Chwee Teck were inducted into the College of Fellows of the American Institute for Medical and Biological Engineering (AIMBE) in honour of their outstanding contributions to the field of biomedical engineering. They were formally inducted at AIMBE’s 25th Annual Event held in Washington DC on 4 April 2016.

Prof Goh is honoured for his exceptional contributions to musculoskeletal biomechanics and active promotion of the field of biomedical engineering, while Prof Lim is recognised for his outstanding contributions in applying cell mechanics and designing innovative microfluidic technologies for disease diagnosis, prognosis and personalised treatment.

Two NUS professors listed on Asian Scientist 100

PROFESSORS Lim Chwee Teck and Andrew Nee were recognised as among Asia’s top 100 scientists in a list published by the Asian Scientist Magazine in January 2016. Their contributions have made significant impact in 2015.

Prof Lim is noted for his outstanding research works in the field of medical and biological engineering for which he was conferred the Vladimir K. Zworykin Award in 2015. Prof Nee, an expert in manufacturing engineering, was awarded the US Society of Manufacturing Engineers Gold Medal in 2014 for his lifelong contributions in the area.

NUS President Prof Tan Chorh Chuan was also featured in the list for his leadership. He was elected in 2015 as a lifetime member of the US National Academy of Medicine and is the organisation’s first Singaporean member.

This is the first time the Asian Scientist Magazine has compiled such a list. To be acknowledged on the Asian Scientist 100 list, one must have received a national or international prize in 2014 or 2015. The prize must involve a competitive selection procedure. Alternatively, in the same period, one could have made a significant contribution in scientific discovery or leadership that has benefited either academia or industry.

“Super cool team” wins ASEAN Outstanding Achievement Award 2015

THE Mechanical Engineering team, led by Associate Professor Ernest Chua Kian Jon, received the ASEAN Outstanding Achievement Award 2015 at the 33rd Conference of ASEAN Federation of Engineering Organisations (CAFEO) on 26 November 2015, in recognition of their outstanding engineering project which made significant contributions to the country’s development. Their cooling system, a collaboration with Professor Ng Kim Choon from the King Abdullah University of Science and Technology, called “Innovative Hybrid Membrane Dehumidifier – Indirect Evaporative Cooling System for All Weather Air-conditioning without Compressor” has key applications in both cooling and dehumidification.

Explaining how the system works, Assoc Prof Chua, the Principal Investigator for the project, said, “The system employs membrane technology to dehumidify moisture-laden air while using an innovative water-based cooler to reduce air temperature to below ‘wet-bulb conditions’ (temperature of air when cooled to saturation). The hybrid system is a highly disruptive cooling technology for all weather applications without the use of high energy-intensive mechanical compressors. I think our technology will make a global impact that we have not witnessed since Carrier invented the Mechanical Vapour Compression cooling system in 1902!”

Besides reducing energy consumption for air-conditioning, the innovative system also contributes to healthier environments in all types of buildings and even modes of transportation. The energy efficiency of commercial and industrial buildings is expected to be markedly improved by at least threefold (from 0.85kW/Rm to 0.28kW/Rm).
**Top wins at Intel Singapore Invent 50 Competition**

At the Intel Singapore Invent 50 Competition held at Marina Bay Sands, final-year Electrical & Computer Engineering students Daniel Lee (Computer Engineering), Teo Yew Shen (Electrical Engineering) and Mikko Val (PhD student) of PD Loggers put their heads together and created a wearable wireless monitoring device for patients suffering from Parkinson’s disease. Powered by Intel® Edison technology, this wireless device provides biofeedback and automated monitoring of gait movements. The team received first prize, taking home $10,000, a laptop with an Intel Sense camera and Intel internship opportunity.

**Hydrone**, a Design-Centric Programme (DCP) team comprising Mervyn, Marshall and Yue Linn, developed a waterproof drone with computer vision to collect water samples and detect various chemicals in the water. Their effort won second prize.

**NUS has been Asia’s top performing university since QS introduced rankings by subject in 2011.**

Five of the Faculty’s subjects were ranked among the top 10. These are:

- Civil & Structural Engineering (7th in World Ranking)
- Chemical Engineering (5th in World Ranking)
- Electrical & Electronic Engineering (4th in World Ranking)
- Mechanical, Aeronautical & Manufacturing Engineering (26th in World Ranking)
- Materials Sciences (29th in World Ranking)

Among Asian universities, NUS Engineering took the top two spots in the following subjects:

- Civil & Structural Engineering
- Chemical Engineering
- Electrical & Electronic Engineering
- Mechanical, Aeronautical & Manufacturing Engineering
- Materials Sciences

**Accorded the esteemed Savio L-Y. Woo Young Researcher Award**

**Snowstorm, Singapore’s first personal flying machine, lifts off**

DCP supervisor for the project, Dr Joerg Weigl, said they built the machine primarily as a means to fulfill everybody’s dreams of flying. Added Associate Professor Martin Henz who is with the USP and NUS School of Computing, “Recent advances in motors and battery technology have made it possible for us to literally take to the skies. We will continue to fine-tune Snowstorm, working on mechanical safety measures, propeller and motor configurations, and control software and hardware to achieve the high levels of safety, simplicity and performance required for recreational use by the general public.”

Dr Thomas Teh, a research fellow with NUS Biomedical Engineering, received the prestigious Savio L-Y. Woo Young Researcher Award at the recent International Symposium on Ligaments & Tendons – XV (ISLT-XV). Representing the highest honour of the Symposium, this award is presented to young researchers who perform the best research studies in three major areas of the field – biomechanical, biological and clinical/translational.

With Dr Teh’s work on the augmentation of tendon graft anterior cruciate ligament reconstruction outcome using a silk-based osteoconductive sheath, he is the first to be recognised for the translational research category of this award.
Doubling shelf life of perishable food with eco-friendly packaging film

NUS researchers have successfully developed an environmentally-friendly food packaging material that doubles the shelf life of perishable food, such as bread. Derived from crustacean shells, free from chemical additives and fortified with grapefruit seed extract (GSSE), the film has immense potential in food technology due to its biocompatibility, non-toxicity, short-term biodegradability and excellent film-forming capability.

The research team, led by Assistant Professor Duong Hai Minh, have filed a patent in the USA, China, India and Southeast Asia. The patent application covers the production of multi-use cellulose aerogels – the aerogels are water repellent and capable of absorbing oil from water – up to 90 times their dry weight, making them up to four times more effective than commercial oil sorbents. Furthermore, they can be “squeezed” to recover over 99 per cent of the crude oil absorbed.

Dr Duong Hai Minh (right) holds a sample of the cellulose aerogel which he developed with his team members, Gu Bowen (centre) and Siah Jie Yang (left), who are both undergraduate students from the Department of Mechanical Engineering.

The researchers estimate that the cost of producing the film will be 30 per cent more than the normal food wrap. If the cost is significantly lower, the researchers are confident that the film’s green features will appeal to those who would buy premium products. The research received support from the Agency for Science, Technology and Research’s Singapore Food Agency (SFA) – which is administrated by the National Research Foundation (NRF) and Industry Partner, Royal Dutch Shell.

A team from the NUS Centre for Energy Research and Technology (CERT) led by Dr Praveen Linga, Assistant Professor of Chemical and Biomolecular Engineering, is developing a prototype to produce purified water from seawater by harnessing the cold energy of LNG via the gas hydrate based desalination (HBD) technology. This research project is under the Energy Innovation Research Programme (EIRP) – which is administrated by the Energy Market Authority (EMA) and funded by the National Research Foundation (NRF) and Industry Partner, Royal Dutch Shell.

The major challenges that impede the commercialisation of the HBD process are the slow kinetics of hydrate formation, crystal separation from concentrated brine solution and cold energy required for the process.

Dr Linga, “Our team is developing a new technique that employs a fixed porous bed made up of sand and water. When propane is employed as one of the hydrate formers in a gas mixture, hydrate crystals form above -162 °C to 20 °C at LNG terminals. Developing innovative technologies to make use of the cold energy is a key area of research and development.

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For a successful industrial scale application of the HBD process, high energy requirement is a pressing issue that needs to be addressed. To solve this issue, Dr Linga and his team – Prof Kanimi, Prof Farooq, Dr Fonnavilavan Babu, Dr Kinar Bandaran and Mr Abhishek Nambiar – are the first to propose an innovative approach by integrating the HBD process with LNG cold energy from the LNG regasification terminals. By using this cold energy for cooling the HBD process, it would be possible to drastically reduce the energy requirement and make it economically feasible. The team is now working to build a prototype of the HBD technology to prove its economic and technical feasibility. If successful, this could mark a new milestone in developing innovative desalination technology.
**Robotic glove helps stroke patients regain hand mobility**

LED by Assistant Professor Raye Yeow, the NUS Biomedical Engineering team has designed and developed a robotic glove which can help stroke patients restore the use of their hands. Conventional devices for hand rehabilitation consist of rigid electromechanical components which are heavy and uncomfortable for patients. The team’s novel device known as EsoGlove is light, made entirely of soft components and does not require complicated mechanical setups.

Acting on air pressure, embedded soft actuators apply forces distributed along the length of the finger to promote movements such as bending, extending and twisting. Unlike conventional devices with rigid links and joints, the glove does not hamper natural movements.

Equipped with sensor technology that can detect and interpret muscle signals, EsoGlove is able to assist patients in daily activities such as holding a cup.

Said Dr Yeow who specialises in soft wearable robotics, “For patients to restore their hand functions, they need to go through rehabilitation programmes that involve repetitive tasks such as gripping and releasing objects. These exercises are often labour intensive and performed in clinical settings.”

The team, which includes PhD candidate Mr Yap Hong Kai and undergraduate student Mr Benjamin Ang, worked with Dr Lim Jeong Hoon, Department of Medicine, to create the device. Mr Yap, who is with the NUS Graduate School for Integrative Sciences and Engineering, added, “As the soft actuators are made from non-ferromagnetic materials, they are suitable for use in functional magnetic resonance imaging studies. We hope that the robotic glove can contribute towards investigating the brain’s activity in relation to motor performance during hand rehabilitation, and unravel the functional effects of soft rehabilitation robotics on brain stimulation.” Pilot clinical studies would be conducted to validate the device’s performance.

**Engineering, the Swiss way**

NUS Engineering graduates can pursue a post-graduate degree, while learning the ropes of entrepreneurship at the latest NUS Overseas College (NOC) in Switzerland. The new NOC at the École Polytechnique Fédérale de Lausanne (EPFL) will receive its first batch of students in July 2016. The new NOC is the seventh overseas college set up by NUS after Beijing, Tel Aviv, New York, Shanghai, Silicon Valley and Stockholm. This collaboration with NUS represents EPFL’s first venture with an overseas university.

NUS engineering graduates will spend six months interning at design and engineering firms in Switzerland, while taking entrepreneurship-related courses at the university. EPFL will also send its students on an exchange programme to NUS, a feature unique to this NOC.

Dean of Engineering Professor Chua Kee Chaing said that the tie-up with EPFL provides another avenue for the students under the Global Engineering Programme to “immerse in an entrepreneurial environment”, while deepening their technology knowledge. “For deep technology, the barrier for entry is high, which gives an edge to new businesses with such expertise”, he explained.
Meet R16, the latest FSAE race car

The latest NUS FSAE race car was unveiled with much excitement on 6 April at the Faculty of Engineering’s foyer. Christened ‘R16’, the newest car represents a key blend of technology and features with the unique NUS FSAE’s signature car design. One visible aspect of the new car is its side wings, which were not present in previous models. Together with its strong aero dynamic design and other elements that allow faster and smoother cornering and better engine lubrication, the car’s racing performance is fully optimised. The car was disassembled after the launch and the parts shipped to Michigan, USA for the annual Formula SAE International Challenge, held from 11 May to 14 May.

The NUS FSAE race car project started in 2001. It now comes under the umbrella of the Engineering Design and Innovation Centre (EDIC) which was established by the Faculty of Engineering. At the annual international FSAE competition in USA, the car and team represent NUS and Singapore, as they are the only participating team from this region.

The race car project, initiated by NUS FSAE Faculty Advisor Professor Seah Kar Heng, involves the combined talents and skills of selected engineering students from Year 2 to Year 4. It provides the students with an exciting opportunity to design, translate technology and realise their ideas on the race track.

Industry collaboration in water research in China

THE Nanjing International Water Hub (NIWH), a project being developed by Sembcorp Development Ltd (Sembcorp), signed a Memorandum of Understanding (MOU) with NUS to formalise collaboration between NIWH and the Faculty’s Centre for Water Research to jointly develop a research centre at NIWH. NIWH is located at the Sino-Singapore Nanjing Eco Hi-tech Island in Nanjing, China.

The NUS FSAE 2016 team with NUS Engineering Dean Prof Chua Kew Cheng (front row), 5th from the right; FSAE Faculty Advisor, Prof Seah Kar Heng (3rd from Prof Chua’s right), Design-Centric Programme Director, Assoc Prof Loh As Fuh 2nd from Prof Seah’s right, and sponsors after launching the NUS FSAE car.

The S$60 million Corporate Laboratory is the newest corporate laboratory that NUS Engineering has established with an industry partner, Sembcorp Industries (Sembcorp). Based at the Faculty, the Corporate Laboratory is also supported by NRF under its Corporate Laboratory@University Scheme, which assists in the setting up of key corporate laboratories via public-private partnerships, and seeks to strengthen Singapore’s innovation system by encouraging public-private research and development collaboration between universities and companies. It also ensures that universities achieve impact by developing cutting edge solutions for problems faced by the industry.

THE Sembcorp-NUS Corporate Laboratory was launched on Wednesday, 20 April. Mr Teo Chee Hean, Deputy Prime Minister and Coordinating Minister for National Security, and Chairman of the National Research Foundation (NRF) Singapore, was the Guest-of-Honour at the launch event.

Named the Water Technology Innovation Centre, the research centre will enhance NUS international visibility and reputation in research and development by supporting research collaboration with leading Chinese universities and commercialising projects with Sembcorp and other industry partners (e.g., Singapore SMEs and Chinese water technology companies) using water-related intellectual property generated by NUS’ Centre for Water Research, as well as by the Water Technology Innovation Centre.

THE Sembcorp-NUS Corporate Laboratory will create a synergetic industry-university partnership to pursue R&D work in three core areas – energy, water and waste-to-resource – to promote and improve environmental sustainability for Singapore. It aims to generate new scientific and engineering knowledge, and develop competitive and sustainable solutions for power generation, industrial wastewater treatment and water reuse, as well as transform waste into high-value products such as ultra-light composites for modular construction.

The Corporate Laboratory will harness the combined expertise of 45 researchers from NUS and 35 engineers from Sembcorp, as well as partner NUS’ research centres, such as the Centre for Water Research and Centre for Advanced Materials Structures, which are located in the Faculty. It will also serve as an important platform for NUS students and researchers to gain experience in industrial R&D, and promote interactions and exchange of ideas with engineers from Sembcorp.

Said Professor Tan Chorh Chuan, NRF President, “NUS is pleased to partner Sembcorp and NRF in setting up the Sembcorp-NUS Corporate Laboratory, which will strengthen the synergy between industry and the academia. We are very excited to have this opportunity to contribute NUS’ expertise in basic and applied engineering research to create knowledge and novel technologies that will enhance the long-term competitiveness of Singapore and our industries, and at the same time improve environmental sustainability. We look forward to working closely with researchers from Sembcorp to develop innovative and sustainable solutions in the areas of energy, water and waste-to-resource.”

The Corporate Laboratory will host the inaugural exhibition featuring capabilities of the Sembcorp-NUS Corporate Laboratory’s three research areas: energy, water, and waste-to-resource.

Partnering to improve environmental sustainability for Singapore

THE NUS ENGINEER
PROFESSOR LUKE P. LEE
Prof Luke P. Lee joined NUS on 4 January 2016 as Director of the Biomedical Research Institute and Technology (BIGHEART) and Associate Professor (International Research and Innovation) in the Office of Deputy President (Research and Technology). He is appointed Tan Chin Tuan Centennial Professor and holds joint appointments in the Department of Biomedical Engineering, Faculty of Engineering and Departments of Medicine and Surgery, Yong Loo Lin School of Medicine.

Prof Lee received both his BA and PhD from UC Berkeley. He joined the faculty at UC Berkeley in 1999 after more than a decade of industry experience. He became the Lester John and Lynne Dewar Lloyd Distinguished Professor of Bioengineering in 2005, and served as Chair Professor in Systems Nanobiology at the Swiss Federal Institute of Technology (ETH, Zürich) from 2006 to 2007. He became the Arnold and Barbara Silverman Distinguished Professor in 2010 and was reappointed in 2015. His work at the interface of biological, physical, and engineering sciences for medicine has received many honours, including the IEEE William J. Morlock Award, NSF Career Award, Fulbright Scholar Award, and the HoAm Prize. Prof Lee is also a Fellow of the Royal Society of Chemistry and the American Institute of Chemical Engineering. In 2014, he was appointed the Goldsmiths’ Professor of Technology (BIGHEART) and Director of Logic Devices Research, where he directed the research and development of advanced device technologies. He was also involved in Design and Process Technology Co-optimisations (DTCO) of emerging technologies targeting 7nm, 5nm, and beyond.

Before 2011, Prof Lee was with Qualcomm’s CDMA Technologies in San Diego, California, USA, where he co-led the Strategic Silicon Technologies Group responsible for new System-On-Chip technology definition and DTCO for upcoming Qualcomm technologies. Prof Lee opened the Semiconductor Research and Development Alliance (ISDA) FEOL and Device Manager at IBM (2007 to 2009), where he co-led an eight-company alliance device/process team to develop the 28-nm and 32-nm low-power bulk CMOS technology at IBM East Fishkill, New York. Before joining IBM, Prof Lee was a senior staff scientist with Motorola’s Advanced Product Research and Development Laboratory (APRL) and Freescale Semiconductor. He subsequently led the Novel Device Research Group there in Austin, Texas, and performed path-finding research on a variety of advanced semiconductor devices.

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Prof Thean graduated from the University of Illinois at Urbana-Champaign, USA, where he received his BS (Highest Honours and graduated as Edmund J. James’ Scholar), MSc, and PhD degrees in chemical engineering from the National Technical University of Athens, Greece. He is a visiting professor in the Petroleum Engineering Department at Texas A&M University, and in the Guangzhou Centre for Renewable Resources of the Chinese Academy of Sciences, as well as an adjunct professor in the Chemical Engineering Department at the Colorado School of Mines, and in the Petroleum and Natural Gas Engineering Department of the Middle East Technical University, Ankara, Turkey. From 2009 to 2010, Dr Moridis was a Distinguished Lecturer of the Society of Petroleum Engineers (SPE) and a SPE Distinguished Member since 2010. He was the recipient of a 2011 Secretarial Honour Award, the highest non-monetary award of the U.S. Department of Energy (DOE), for work on the Deepwater Horizon Oil Spill Flow Rate Technical Group.

Dr Moridis sits on the editorial board of three scientific journals and is an Associate Editor of four scientific journals. He has authored or co-authored over 75 papers in peer-reviewed journals, 3 book chapters, and more than 200 LBNL research paper presentations and book articles. In 2013, he was appointed to the U.S. Secretary of Energy’s methane hydrates advisory committee. He has secured more than US$15 million from various sources as a result of which the majority of which has been for methane hydrate research.

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Professor Cheetham is a top academic leader. He was the Director of Materials Science & Engineering as Distinguished Visiting Professor on 1 April 2016. Prof Cheetham is the Goldsmiths’ Professor of Materials Science at the University of Cambridge. He also serves as the Vice-President and Treasurer of The Royal Society. Prof Cheetham is one of the most eminent scholars, best known for his remarkable work in materials science and engineering, especially in the structure and properties of functional materials (inorganic, organic, and hybrid).

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A niche in digital marketing

HAVE you ever met someone with great personality and bucket loads of energy? Someone who could do almost anything?

Meet Mr Jereme Wong, our alumnus from Electrical and Computer Engineering (ECE) Class of 2001, who is the Chief Operating officer of clickTRUE Pte Ltd, an online consulting firm helping brand owners strategise, design and build captivating experiences for the Web. His interest in digital marketing and online advertising began during his second year in NUS (1998) when he started a media company called Hardware Zone Pte Ltd with some friends. Together, they published a popular technology website, www.hardwarezone.com, as well as managed to launch a few technology magazines in five different countries. The company was later acquired by the Singapore Press Holdings (SPH) in 2006. With the experience gained in media and advertising, Mr Wong and his friends started clickTRUE as a digital agency within the SPH Group. The agency specialises in helping brands achieve performance marketing through various digital channels.

The road to success has not always been smooth sailing. Mr Wong shares some challenges that he encountered during the early days. “Back in 1998, entrepreneurship was not a buzz word like it is today. We did not have much help or many resources. Hence, every step in building a company was not easy. We were also not taught to manage people in school. But somehow, we managed to grow the company to almost 150 staff across five countries.”

He also shares how NUS made him realise that life was more than just academic pursuits. For instance, when Mr Wong signed up for NUSSU Volunteer Action Committee (NVAC) during his first year, he thought he would simply be a normal volunteer without taking up too many responsibilities. However, at that time, there was a new project (Telok Blangah Moral Welfare Home) that had just started, and the Project Director was a Year 4 Engineering student who was about to graduate. Mr Wong was nominated to be the Project Director to take over, even though he had no experience in running a volunteer group. To his surprise, Mr Wong found the volunteer work refreshing and satisfying; he spent weekends organising activities for the destitute and caring for them. Said Mr Wong, “Up to then, my focus had been on academic achievements. However, when I started involving myself with volunteer work, I realised that there is so much more to life than academic pursuits.”

For an engineering graduate to stand out in today’s increasingly changing and competitive economic backdrop, Mr Wong added, “I personally think soft skills are critical for anyone to stand out in today’s competitive landscape. The ability to listen and respond in an appropriate manner is a very important first step to master in the workplace. Getting this right will reveal your maturity in handling issues at work. Thereafter, one needs to be resourceful and able to apply critical thinking skills to solving problems.”