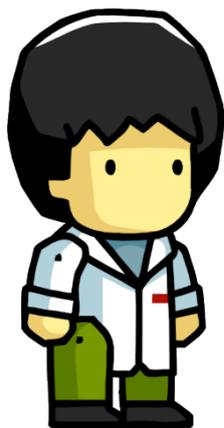


**NANYANG**  
research programme

*Junior*



**NRP<sub>jr</sub> Project**  
**Synopses 2022**

## NANYANG RESEARCH PROGRAMME (JUNIOR RESEARCHER)

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## ENGINEERING

### EEEjr01

<b>Title</b>	Research and development of spectrum-adaptive table lamp
<b>Description</b>	<p>Table lamps currently in the market could have warm or cold white light. Users will choose the one which is suitable for them. However, users typically do not know the scientific reasons for their choice. In fact, our eyes have been evolved to adapt to sunlight, which changes from dawn to dusk with various light spectrum from warm to cool white light. The project will do research on the sunlight spectrum through the day and build the table lamp with a tunable spectrum that can change the spectrum according to the user's need or following the sunlight so that users have a feeling of outdoor light.</p> <p>Students will not only learn about the sunlight spectrum but also control the light with a simple microcontroller (Arduino) and coding.</p>
<b>College / School</b>	School of Electrical & Electronic Engineering
<b>Target Group</b>	Sec 3 / Year 3 and Year 4
<b>Group Size</b>	Pair
<b>Specific Knowledge</b>	NIL
<b>Other Requirements</b>	NIL

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## ENGINEERING

### NIEjr03

<b>Title</b>	Exploring Local Micro-Climates With Open-Source Sensors
<b>Description</b>	<p>You will be using open-source environmental sensors (based on Arduinos) to build a dataset of the microclimate around your home, over a period of time spanning the duration of the project. You and your team-mate will use the datasets to compare the microclimate from your two respective sites, and make reasoned inferences and analyses regarding the variation in the patterns of the data observed. The sensors can be configured to measure variables such as light, temperature, and humidity. They can be self powered and can be configured to run-off regular handphone battery-pack chargers. For extension activities, you and your team-mate could explore modifying and customising the sensors, and / or modifying the source code, and / or thinking about different ways of housing the sensors and weatherproofing them, possibly using fabricated parts which you yourselves design. You will come away with a more informed understanding of how and why microclimate varies over time, using empirical data gathered from your respective local (home) environments. Your study can contribute to wider datasets which the research team are already building in Singapore as well as in other countries in ASEAN.</p>
<b>College / School</b>	National Institute of Education
<b>Target Group</b>	Sec 3 / Year 3 and Year 4
<b>Group Size</b>	Pair
<b>Specific Knowledge</b>	NIL
<b>Other Requirements</b>	You should be prepared to analyse the data you generate using freely available statistical tools found online, as part of your final report and presentation.

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**ENGINEERING**

**SBSjr01**

<b>Title</b>	Ex vivo engineering of cellular surfaces, a transfection independent approach
<b>Description</b>	<p>The identity of mammalian cells is commonly defined by their appearances or the types of surface receptors they present. In the meantime, cells also constantly undergo transformation and such that receptor expression profiles would morph into distinct profiles over time. Such surface receptor profiles are often considered as signatures of different cells types, and hallmarks of immune cell differentiation and development/activation stages. Harnessing this surface receptor distribution would be a convenient method to optimize cell based immuno-therapy. Engineered cells with more stable surface receptor profiles, or with enhanced presentation of functional groups would possess the ideal activities to facilitate research and biomedical applications.</p> <p>In this project, the students would work with an experienced research fellow to optimize and/or co-develop an engineering protocol to modify surface receptors, using enzymatic approaches.</p> <p>Type of lab work involved:</p> <ol style="list-style-type: none"> <li>1. Planning and molecular cloning.</li> <li>2. Biochemistry</li> <li>3. Structural Biology</li> <li>4. Cell biology, immune activation assays.</li> </ol> <p>No chemical hazard, no pathogens.</p>
<b>College / School</b>	School of Biological Sciences
<b>Target Group</b>	Sec 3 / Year 3 and Year 4
<b>Group Size</b>	Pair
<b>Specific Knowledge</b>	This is a suitable beginner's biology project for High school students who have a firm Math background.
<b>Other Requirements</b>	NIL

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## ENGINEERING

### SCBEjr01

**Title** Assessing the Environmental Footprints of Pharmaceutical Nanoparticles by Life Cycle Assessment

**Description** Nanoparticles of active pharmaceutical ingredients (API) have emerged as an effective strategy to enhance the systemic bioavailability of poorly soluble drugs. This is attributed to the fast dissolution rate afforded by the large specific surface area of nanoparticles. The high bioavailability translates to lower dosage requirement compared to the conventional drug formulation by microcrystalline drug particles. The lower dosage requirement also means less drug products need to be produced and less drug is wasted after administration (as most of it will be absorbed by the patient's body), thus smaller environmental footprints from the manufacturing. However, the production of API nanoparticles is time-consuming and energy-intensive process by size reduction by milling or high-pressure homogenisation. This leads to large environmental footprints from the manufacturing.

In this project, we would like to answer the research question whether the smaller footprints afforded by the higher solubility of API nanoparticles are adequate to overcome the larger footprint in their production step? The students will learn how to carry out basic principles of Life Cycle Assessment (LCA) analysis to answer this research question. Students with great interests in medicinal chemistry and mathematics are encouraged to participate.

**College / School** School of Chemical & Biomedical Engineering

**Target Group** Sec 3 / Year 3 and Year 4

**Group Size** Pair

**Specific Knowledge** Basic Chemistry

**Other Requirements** NIL

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## ENGINEERING

### SCBEjr02

<b>Title</b>	Process Simulation
<b>Description</b>	Chemical engineering is not just about experiments, but also about playing with simulation software. In this project, we shall look into various parts of the chemical plant. We shall employ the Aspen HYSYS modelling platform - a user-friendly and exciting tool - to simulate and understand the operation of different operations of chemical plants. The aim of this project is to give students a light appreciation of some core chemical engineering fundamentals with the aid of typically used simulation tools.
<b>College / School</b>	School of Chemical & Biomedical Engineering
<b>Target Group</b>	Sec 3 / Year 3 and Year 4
<b>Group Size</b>	Pair
<b>Specific Knowledge</b>	Students will be doing modelling.
<b>Other Requirements</b>	NIL

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SCIENCES

NIEjr02

<b>Title</b>	Acute Effects of Using Reusable Cloth Mask During Aerobic Exercise
<b>Description</b>	As Coronavirus Disease 2019 evolves to become an epidemic and the future of mask wearing activities is unknown, understanding the physiological effect and exercise performance with reusable cloth mask (RCM) is essential. It is hypothesized that RCM impedes airflow transmission between environment and user, hence a negative impact on the ventilatory breakpoint (V <sub>pt</sub> ) and physiological variables (i.e. blood lactate, heart rate and oxygen consumption). However, the understanding is not concrete and many other studies conducted on surgical mask shows conflicting results. There are three objectives to the study: 1) To investigate the physiological effects of reusable cloth mask (RCM) worn during exercise, 2) To investigate the perceived exertion level and perceptual discomfort of RCM during aerobic exercise, and 3) to determine the appropriate exercise intensity level while wearing a RCM during exercise for healthy adults. The study will look into the physiological makers, perceptual mask discomfort, and rate of perceived exertion during aerobic exercise. The study adopts a randomized crossover counterbalanced experimental design. All participants will be randomly assigned into the experimental (with RCM) or control group (without RCM) and the changeover will take place in the following week. A submaximal graded exercise treadmill protocol will be used to conduct the experiment where the ventilatory breakpoint will be identified. The protocol requires participants to run and rest for four minutes each, on an alternate basis until volitional exhaustion is achieved.
<b>College / School</b>	National Institute of Education
<b>Target Group</b>	Sec 3 / Year 3 and Year 4
<b>Group Size</b>	Pair
<b>Specific Knowledge</b>	<ol style="list-style-type: none"> <li>1) Communication skills</li> <li>2) Attention to details</li> <li>3) Adhere to protocols and guidelines for safe procedures in laboratory</li> <li>4) Positive learning attitude and open mind</li> <li>5) Basic understanding of human anatomy, circulatory and respiratory systems, effect of exercise and training</li> </ol>
<b>Other Requirements</b>	NIL

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SCIENCES

NIEjr05

<b>Title</b>	Development of Graphene / Metal Interfaces for Large Spin-Orbit Interaction
<b>Description</b>	Spintronics (means spin+electronics) deals with the spin of electron for the development of futuristic logic and memory devices with ultra-high speed and high storage capacity. To achieve futuristic spintronics devices, high spin current to charge current and charge current to spin current inter-conversion efficiency is need. Till date, maximum inter-conversion efficiency is reported to be 33% in tungsten and need to be improved to realize spin devices for practical applications. To enhance this inter-conversion efficiency, system with large and tunable spin-orbit interactions is required. In the present proposal, we propose a 2 dimensional graphene/metal interface which can result in the large spin orbit interaction due to the presence of free electron in the graphene and difference in the chemical potential at the metal-graphene interfaces. Hence, in the present proposed research, graphene interfacing with metal is opted to develop new cost effective and non-toxic high spin orbit materials. Approach can help in the progress of the spin-orbit engineering to achieve large charge to spin conversion efficiency which is highly desired to accelerate this emerging field of research and application. The proposed research not only places an academic impact but also create a technological impact.
<b>College / School</b>	National Institute of Education
<b>Target Group</b>	Sec 3 / Year 3 and Year 4
<b>Group Size</b>	Pair
<b>Specific Knowledge</b>	Good hands-on experimental science and keen to learn basic Physics and Chemistry.
<b>Other Requirements</b>	NIL

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**BUSINESS, HUMANITIES, ARTS & SOCIAL SCIENCES**

**NIEjr01**

<b>Title</b>	Topics in Singapore English
<b>Description</b>	For this project, we will work on natural language data from Colloquial Singapore English (otherwise known as Singlish). Data will either be collected through elicitation/production tasks, designed experiments, or from existing corpora/data sets. Singapore English is a contact variety of English with several unique features. The specific aspect of Singapore English, as well as how the data is analysed will depend on the linguistic subfield of your choice: syntax (structure), semantics/pragmatics (meaning), or phonology/phonetics (sound). I am fine with adopting whatever linguistic framework you prefer to use.
<b>College / School</b>	National Institute of Education
<b>Target Group</b>	Sec 3 / Year 3 and Year 4
<b>Group Size</b>	Pair
<b>Specific Knowledge</b>	Native speaker of Singapore English, or have easy access to one. Good intuition, interest and curiosity in the way language is produced and processed.
<b>Other Requirements</b>	NIL

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**BUSINESS, HUMANITIES, ARTS & SOCIAL SCIENCES**

**NIEjr04**

<b>Title</b>	Exploring Digital Tools and Methods for Investigations within the field of Humanities
<b>Description</b>	<p>In this project, you will learn how to use digital tools and methodologies to investigate a Humanities-related topic of your choice. The field of Digital Humanities is broad, so potential projects might involve (though are not limited to) using text mining tools to analyse historical texts, using Geographical Information Systems (GIS) to analyse maps, or using network analysis to analyse relationships between characters in a work of literature.</p> <p>You will be guided through the design of a project, which will be crafted to align with your own interests as feasibly possible. As such, you will come away with a deeper understanding of how digital tools can be used to analyse and interpret data within your chosen Humanities topic.</p>
<b>College / School</b>	National Institute of Education
<b>Target Group</b>	Sec 3 / Year 3 and Year 4
<b>Group Size</b>	Pair
<b>Specific Knowledge</b>	NIL
<b>Other Requirements</b>	NIL

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**BUSINESS, HUMANITIES, ARTS & SOCIAL SCIENCES**

**NIEjr06**

<b>Title</b>	Food Allergy Knowledge, Attitudes, and Preparedness Among Consumers and School Canteen Service Personnel
<b>Description</b>	Allergies to food is a common occurrence, yet consumers with allergies often react adversely after consuming certain foods because they were not aware of the ingredients used to make the food product. Therefore it is pertinent that food service providers have the knowledge on common food allergen. Food products sold off the shelves should also include warnings of potential allergens. This research aims to determine the knowledge/awareness of food allergens among front of the house (FOH) workers, as well as consumers. Data collected will be useful in designing initiatives/programmes that can help the food industry and general public.
<b>College / School</b>	National Institute of Education
<b>Target Group</b>	Sec 3 / Year 3 and Year 4
<b>Group Size</b>	Pair
<b>Specific Knowledge</b>	NIL
<b>Other Requirements</b>	NIL

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**BUSINESS, HUMANITIES, ARTS & SOCIAL SCIENCES**

**SOHjr01**

<b>Title</b>	Singapore Crypto-Linguistics: Deciphering the Singapore Stone
<b>Description</b>	The Project is aimed at trying to solve the puzzle of the yet-undeciphered writing system of the Singapore Stone, with the goal to unveil the language hidden behind that mysterious script. Tasks include internal analysis of Singapore Stone's writing system and documentary research. Make grammatological comparisons with possibly related scripts. Work with a multidisciplinary Research Team trying to find new answers to this enigma. The Project has also an archaeological component in the search for the 'missing' fragments of the Singapore Stone, 'lost' on the route between the Indian Museum at Calcutta and the National Museum of Singapore. Moreover, on the computational side, we'll try to apply the Gröbner Basis principles, implemented into an algorithm especially developed for the Project, to the fragmentary text of the Singapore Stone, aiming at reconstructing, in its entirety, the text itself. This would provide us and scholars all over the world with a possibly reliable document to work on for the interpretation of the Singapore Stone and its unique writing system and, ultimately, for its decipherment.
<b>College / School</b>	School of Humanities
<b>Target Group</b>	Sec 3 / Year 3 and Year 4
<b>Group Size</b>	Pair
<b>Specific Knowledge</b>	None - Optional: elementary Python Programming experience; elementary Computer Graphics experience.
<b>Other Requirements</b>	NIL

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**BUSINESS, HUMANITIES, ARTS & SOCIAL SCIENCES**

**SOHjr02**

<b>Title</b>	Become a Glyph-Breaker: Deciphering Linear A
<b>Description</b>	<p>The Project tries to solve the puzzle of the yet-undeciphered Aegean writing system of ancient Crete, Linear A, dating back to the Bronze Age, and of the unknown language hidden behind the script, Minoan. Tasks include internal analysis of Linear A tablets, corpus analysis of Linear A, development of crypto-linguistic approaches to the Linear A texts, application of an experimental methodology aimed at deciphering Linear A. The external analysis component includes comparisons, at the grammatological and linguistic level, with other (possibly related) ancient writing systems and languages of the Mediterranean, conducted both according to philological methodologies and to cryptanalytic methods. In particular, the Project aims at developing a cryptanalytic 'brute force attack' on the undeciphered Linear A writing system, by testing and implementing advanced elements of a software to accomplish the first complete cryptanalytic attack on Linear A, possibly reconstructing the Minoan phonetics and phonology and isolating significant clusters of symbols. That would lead to the decipherment of the undeciphered Aegean writing system. The test and possible 'cryptanalytic attack' will be implemented by using a Python programme specially developed for this task. The pioneering Research associates Crypto-Linguistics, Historical Linguistics, and Language Deciphering with Digital Humanities and Computer Science. An additional component of the Project is aimed at the development of the first complete digital corpus of Linear A. The goal is, eminently, to reproduce one-by-one all the Linear A documents, from clay tablets to vase inscriptions, and to digitize them, in order to provide a complete digital corpus independent from the physical books and collections of Linear A currently available. This component of the Project is in Digital Humanities, requiring some expertise in Computer Graphics (and, optionally, in Freehand Drawing). No previous knowledge of the Linear A writing system or of Aegean Archaeology is, conversely, expected. The Linear A Digital Corpus would be the first complete digitized corpus of this Aegean writing system and would represent a valuable instrument for scholars all over the world working on the decipherment of Linear A. Moreover, it would be an original contribution to the field of Corpus Linguistics.</p>
<b>College / School</b>	School of Humanities
<b>Target Group</b>	Sec 3 / Year 3 and Year 4
<b>Group Size</b>	Pair
<b>Specific Knowledge</b>	None - Optional: elementary expertise in Applied Mathematics, Computer Algebra, Computational Algebraic Geometry, and Computational Commutative Algebra.
<b>Other Requirements</b>	NIL

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**BUSINESS, HUMANITIES, ARTS & SOCIAL SCIENCES**

**SOHjr03**

<b>Title</b>	Arab philanthropies and how they influence the spread of Arabic Language on Singapore landmarks
<b>Description</b>	Alkaff Mansion, Aljunied MRT station, Bussorah Street - what do they have in common? In ancient Singapore, Arab philanthropists have played a fundamental role in turning a sleepy, fishermen's island into one of the most bustling trade hubs in Southeast Asia. These individuals, such as Syed Omar Aljunied, were wealthy merchants and philanthropists who arrived in Singapore during a time where new opportunities for trade abound in newly set up Singapore. Their contributions were monumental as they had played a part in the developments of key infrastructure in Singapore. How has their influence pervaded the Singaporean landscape especially in the names of streets and landmarks? How have these names evolved or changed over the years? This study seeks to understand how significant these philanthropists were such that their names have been eternalized in Singapore's landmarks.
<b>College / School</b>	School of Humanities
<b>Target Group</b>	Sec 3 / Year 3 and Year 4
<b>Group Size</b>	Pair
<b>Specific Knowledge</b>	None - Optional: elementary Python Programming experience; elementary Computer Graphics experience.
<b>Other Requirements</b>	NIL

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**BUSINESS, HUMANITIES, ARTS & SOCIAL SCIENCES**

**SCIjr01**

<b>Title</b>	Who Are Chatbots?: A Study of Company Digital Personas
<b>Description</b>	<p>People increasingly encounter chatbots or “virtual agents” when they visit websites. The companies and organisations that control these websites have a choice of what persona to attach to their chatbots. Jamie is a well-known example in Singapore, but Jamie is a relatively young woman with a professional appearance. Not all chatbots are presented this way.</p> <p>In this research project, the NRP student will conduct a sweeping inventory of websites and the chatbot personas attached to them. Our goal is to see if certain industries or public functions tend to present chatbots in certain ways. For example, is it more common to find a “male” chatbot on a financial services company webpage?</p> <p>Our analysis can extend beyond just visiting websites and taking notes. The NRP researcher may choose to interact with the chatbot to see what the “personality” is. Is it formal, informational, positive, neutral?</p> <p>The majority of this project is completed on the timeline that suits the NRP student. Most of the project is truthfully just browsing the web and taking notes. While this may seem simple, the volume of data required is massive; the NRP student should plan on dedicating a few hours each week to the project, on average. The NRP student may choose to also be involved in data analysis and visualisation near the conclusion of the project.</p> <p>This project is excellent for NRP students who need flexibility and also have exceptional self-discipline. It is also excellent for students who wish to think carefully about the best way to create a representative sample of companies and organisations.</p>
<b>College / School</b>	Wee Kim Wee School of Communication and Information
<b>Target Group</b>	Sec 3 / Year 3 and Year 4
<b>Group Size</b>	Pair
<b>Specific Knowledge</b>	Requires the ability to browse the internet and take notes in a spreadsheet. Project does require self-discipline as the project timeline will move in 2-4 phases; this means the student will need to self-manage workload during these phases.
<b>Other Requirements</b>	NIL

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**BUSINESS, HUMANITIES, ARTS & SOCIAL SCIENCES**

**SCIjr02**

<b>Title</b>	Top Dog in the Lion City: Experiences with Singapore's Robotic Pup
<b>Description</b>	<p>Do you remember the yellow robotic dog thing that was deployed to some parks and park connectors at the start of the circuit breaker? It was supposed to tell people to socially distance etc. The “dog” went from instagram celebrity to just-a-normal-part-of-life in just a few days. Why? This is one of the only real-world deployments of a robotic enforcer, your job is to figure out how people in SG experienced this event.</p> <p>The best way to figure out how Singaporeans feel about the robotic dog is to talk with people who interacted with it. This means the NRP student will want to recruit interview subjects that are likely to have encountered this robotic dog. Bishan-AMK was one of the park corridors where this dog could be found; therefore this NRP project is especially well-suited to students who live nearby or who have many friends/family in that area.</p> <p>The majority of the work in this NRP project will be finding people and then getting them to agree to a brief interview. For the well-networked student who enjoys talking to people, this will be relatively easy. However, transcribing interviews can be a chore, so the NRP student must have excellent discipline and work ethic. The NRP student should also be courageous and prepared to “steer” the interview in the intended direction. For example, an interview subject may diverge from the interview topic to talk about related things like surveillance, privacy, robots, or treatment of animals. The NRP student will need to have the social skills needed to ask the right questions and get the interview back on track - your mentor can help give you some key lines that you can use for this purpose.</p> <p>After collecting approximately 20 interviews (10-20 minutes each), the NRP student can choose to participate in the analysis as we read the transcripts to figure out how Singaporeans experienced this interesting event. Who knows if yellow robotic dogs will ever patrol Singapore parks again, your work will cement this moment in history for future generations to read about.</p>
<b>College / School</b>	Wee Kim Wee School of Communication and Information
<b>Target Group</b>	Sec 3 / Year 3 and Year 4
<b>Group Size</b>	Pair
<b>Specific Knowledge</b>	The most important “skill” for this project is having a large social network and a willingness to recruit interview subjects. This will especially be the case if the student lives near one of the areas that the robot was deployed (e.g., Bishan-AMK park corridor).
<b>Other Requirements</b>	NIL

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