TISF2023

Thailand International Science Fair

PROCEEDINGS

February 13 - 16, 2023

@Mahidol Wittayanusorn School, Thailand

Mapping Out the Future

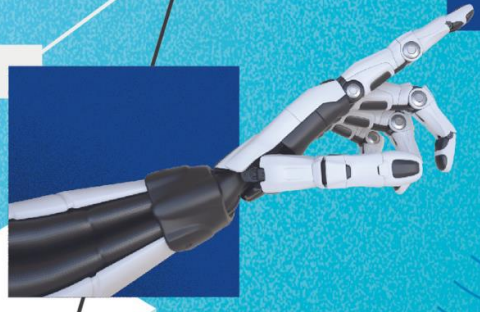

Table of Contents

Thailand International Science Fair 2023

“Mapping Out the Future”

Central to the theme of our TISF this year is a discourse on our steps forward together. The recent global pandemic was yet another reminder of how swiftly our modern world can change. At the same time, it allows us to realize a higher degree of our potential in adapting to and overcoming obstacles of such unprecedented scale.

It is, nevertheless, important to recognize that such ability was hardly innate in nature. It was the culmination of our studies and experiences that led us through and these greatly derive from active collaboration. It is the very goal of TISF to establish a platform for such dialogues and sharing of ideas. As we move forward, much uncertainty awaits. This is especially true for young researchers in this era of disruptive technological advancements. As they forge their paths towards the future, it is imperative that they are well-equipped with a diverse range of prospects and skills and we hope that our TISF serves everyone well for the challenges ahead.

Message from the Chairperson of the Executive Board of MWIT

On behalf of Mahidol Wittayanusorn School, this year's event host, it is with great honor to welcome all the participants to the Thailand International Science Fair 2023 (TISF 2023).

Through the years, Thailand has been putting efforts in pursuing science, technology and innovation towards economic competitiveness and sustainable development. It is indisputable that science and technology are the driving forces behind changing the way we live. Therefore, education plays an important role in ensuring that they are accessible and beneficial to all, adhering to the highest ethical standards and values of society. With this in mind, our school is always proud to host the TISF, where young yet passionate, keen and bright minds come together to showcase talents and creativity through innovations.

This year, we are excited to have budding and enthusiastic students who will not only have the opportunity to share their scientific explorations but will also partake in collective actions to map out the future of science and technology. The cooperation and coordination of these motivated, zealous and vigorous students are going to create a collaborative roadmap for translating research findings into products, services, and careers for tomorrow.

It is with hope that participants will find the event exciting, challenging and fun. May the memories, knowledge and friendships you gain from this event empower and inspire you to become the thinkers and leaders the world so desperately needs in the future.

Asst. Prof. Dr. Yuvadee Nakapadungrat
Acting MWIT Executive Board Chairperson

Message from the Principal of MWIT

As the principal of Mahidol Wittayanusorn School, it is my honor to welcome all participants to the Thailand International Science Fair 2023 (TISF 2023). At TISF we aim to enhance collaboration amongst young researchers from around the world. This event allows future scientists to exchange ideas, projects, and innovative theories that will bring forth development not only in our respective countries, but internationally. Though the circumstances surrounding the global pandemic have created challenges for us throughout the years, we believe that our tenacity to overcome these obstacles has been proven through the hard work and dedication each participant has shown.

TISF gives us a great opportunity to collaborate, unite, and exchange ideas through science and cultures in order to strengthen society as a whole. We have full confidence that all administrators, educators, and students will have a joyous experience. We are proud to host TISF 2023 and look forward to seeing the different projects that will intrigue the mind and spark curiosity throughout the week.

Worawarong Rakreungdet, Ph.D.
Principal
Mahidol Wittayanusorn School

Program Schedule

Sunday, February 12th, 2023

Time	Students		Principals & Teachers	
	Program	Location	Program	Location
All day	Arrival of participants/ Registration			1st floor, Bldg. 9
13.00-17.00	Leisure Activities			1st floor, Bldg. 9
	Poster set up	Sports Center		
17.00-19.00	Dinner			Cafeteria

Monday, February 13th, 2023 **Dress code:** [Principal & Teacher] Formal attires/ [Student] School uniforms

Time	Students		Principals & Teachers	
	Program	Location	Program	Location
05.00-06.30	Breakfast	Cafeteria	Breakfast	• Cafeteria • 1st floor, Bldg. 1 (Principals)
06.15	Registration for Opening Ceremony			1st floor, Bldg. 3
06.45-07.15	All team members proceed to the auditorium for the Opening Ceremony			Phra Ubali Kunupamachan Auditorium
08.30-11.00	Opening Ceremony presided over by H.R.H. Princess Maha Chakri Sirindhorn			Phra Ubali Kunupamachan Auditorium
11.00-13.00	Lunch			• 1st floor, Bldg. 1 (Principals) • Cafeteria (Other Participants)
14.00-17.00	Poster Presentation			Sports Center
17.00-17.50	Group Photo			Football field
17.50-20.30	Welcome Dinner			Basketball court

Tuesday, February 14th, 2023 **Dress code:** [Principal & Teacher] Business casual attires/ [Student] School uniforms

Time	Students		Principals & Teachers	
	Program	**Location**	**Program**	**Location**
07.00-08.00	Breakfast	Cafeteria	Breakfast	• Cafeteria • Reon Kruewal (Principals who stay at Reon Kruewal)
08.30-12.00	**Oral Presentation** Venue 1: Theater Venue 2: Dr. Kovit Meeting Hall Venue 3: Dr. Nat Meeting Hall Venue 4: Room 1303			
12.00-13.00	Lunch	Cafeteria	Lunch	Cafeteria
13.00-17.00	**Science Activities** • Aesthetics Physics (Physics) • Chemtasty (Chemistry) • Catch Me If You Can (Biology) • Mathscape (Maths & Com) • The Extraterrestrial Columbus (STEM)	1st floor, Bldg. 9	(13.00-14.00) Principal Panel Discussion (14.00-16.00) Teacher Sharing Session (16.00-17.00) Science Activities (Observation)	• Theater • Theater & Dr. Kovit Meeting Hall
17.00-19.00	Dinner	Cafeteria	Dinner	• Cafeteria (Teachers) • Riverside Dinner Cruise Bangkok (Principals)
19.00-21.00	Game Night	Phra Ubali Kunupamachan Auditorium		

Wednesday, February 15th, 2023 **Dress code:** [Principal & Teacher] Smart casual attires / [Student] TISF T-shirt (Cream color)

Time	Students		Principals & Teachers	
	Program	**Location**	**Program**	**Location**
06.00-07.00	Breakfast	Cafeteria	Breakfast	• Cafeteria • Reon Kruewal (Principals who stay at Reon Kruewal)
07.00	Gathering at Basketball court Depart for National Science and Technology Development Agency (NSTDA)			Basketball court
09.00 -15.00	**Science Zones** **Group 1:** MTEC/ENTEC and LED **Group 2**: NBT and Plant Factory **Group 3:** Board Game and Plant DNA Fingerprint **Group 4:** Food Innovation and NBT **Group 5:** Fab Lab: Drone and ThaiSC **Group 6:** NANOTEC and Board Game **Group 7:** NANOTEC and NFEC **Group 8:** ThaiSC and Food Innovation **Group 9:** Plant Factory and Fab Lab: Drone **Group 10:** LED and MTEC/ENTEC			
15.00	Depart for MWIT			
18.00-20.00	Dinner and Cultural show preparation			Cafeteria

Thursday, February 16th, 2023 **Dress code:** [Principal & Teacher] TISF Polo Shirt / [Student] TISF T-shirt (Green color)
Sleeveless shirts & shorts are NOT ALLOWED

Time	Students		Principals & Teachers	
	Program	**Location**	**Program**	**Location**
06.00-07.00	Breakfast	Cafeteria	Breakfast	• Cafeteria • Reon Kruewal (Principals who stay at Reon Kruewal)
07.00-07.30	Gathering at Basketball court Depart for the Temple of the Emerald Buddha & National Museum Bangkok			Basketball court
09.00-11.30	Cultural Excursions			The temple of the Emerald Buddha & National Museum Bangkok
11.45	Depart for ICONSIAM			
12.30-15.30	Lunch & Souvenir Shopping			ICONSIAM
15.30	Depart for MWIT			
18.00-19.00	Dinner			Cafeteria
19.00-21.00	Closing Ceremony and Farewell Party			Phra Ubali Kunupamachan Auditorium

Friday, February 17th, 2023

Time	Students		Principals & Teachers	
	Program	**Location**	**Program**	**Location**
All day	Departure of Participants			
06.00-07.00	Breakfast	Cafeteria	Breakfast	• Cafeteria • Reon Kruewal (Principals who stay at Reon Kruewal)
11.00-13.00	Lunch			Cafeteria

Remark: The schedule is subject to change.

Keynote Speaker

Professor Sukit Limpijumnong

Topic:

Future technologies that will change our world

Professor Sukit Limpijumnong received a scholarship, Development and Promotion of Science and Technology Talents Project (DPST) scholarship, from the Thai government since high school. He received Ph.D. in Physics with specialization on computation materials from Case Western Reserve University, USA and did postdoctoral trainings at Xerox Palo Alto Research Center in Silicon Valley, USA.

In 2001, Prof. Limpijumnong started his teaching career at Suranaree University of Technology and become a full professor of physics in Thailand at the age of 34. He also performed many short-term research visits as a visiting professor in many world-renowned computational material labs such as National Renewable Energy Laboratory (NREL) and Oak Ridge National Laboratory (ORNL).

Prof. Limpijumnong was a vice rector of Suranaree University of Technology for 8 years and a director of Research Center for Computation and Theory of Thailand Center of Excellence in Physics (ThEP Center) for 9 years where he and colleagues conducted numerous impactful frontier research on computational materials on metal oxides and nanostructure solids. He has over 100 ISI indexed publications with H-index of 36 and over 5,700 citations. His life-time achievements were recognized by many national and international bodies, for examples, National Outstanding Researcher Award (2011) and TWAS Prize for Young Scientists (2004).

In 2018, Prof. Limpijumnong was appointed as the president of the Institute for the Promotion of Teaching Science and Technology (IPST), a state-run organization in charge of developing and research of curricula, teaching and learning techniques and evaluation in sciences, mathematics and technology at all education levels with focus on basic education of Thailand, professional development of teachers in science, mathematics and technology, raising and evaluating scientific literacy of the next generation of Thai citizens, and promote as well as support Thai talented sciences, mathematics and technology students and teachers to participate in national and international promotion projects. During the pose of IPST President, Prof. Limpijumnong has initiated several impactful projects on Thai education such as development textbooks and teacher's guides and implement computing science curriculum or “Coding” for all educational levels in basic education, digital transformation of textbooks according to COVID-19 pandemic called “Project 14”, Japan-Thailand collaboration project, Training and Development Project in Engineering, Technology and Innovation to Support the Investment and Enhance National and Regional Industrial Capabilities (Thai KOSEN Project), for establishing Japanese-style colleges of technology in Thailand to Support investment and increase industrial capacity in the country and region.

In 2022, Prof. Limpijumnong was appointed as President of the National Science and Technology Development Agency (NSTDA).

Keynote Speaker

Associate Professor Taweetham Limpanuparb

Topic:

Why must scientists speak up for science?

Education

• Ph.D. (Quantum Chemistry), Research School of Chemistry, The Australian National University (ANU), Canberra, Australia, 2012

• B.Ed. (Educational Technology and Communication), Sukhothai Thammathirat Open University (STOU), Nonthaburi, Thailand, 2018

• LL.B. (Law), Sukhothai Thammathirat Open University (STOU), Nonthaburi, Thailand, 2015

• B.Sc. (Distinction program in Chemistry, First-class honors), Faculty of Science, Mahidol University (MU), Bangkok, Thailand, 2008

• Certificate of upper secondary school, Mahidol Wittayanusorn School (MWIT), Nakhon Pathom, Thailand, 2004

Experience

• *Faculty member*, Chemistry Program, Science Division, Mahidol University International College, Mahidol University, Thailand

- Academic position: *Associate Professor* (2018–), *Assistant Professor* (2015–18), *Senior Lecturer* (2015–17), *Lecturer* (2012–15)
- Program Director/Chair of Chemistry Program (2018–2022) - Recognition of MUIC's Chemistry Program by American Chemical Society (ACS) – the first in Thailand and in Asia-Pacific

• Senior Visiting Fellow (Level D), School of Chemistry, UNSW (2022–23)

• Postdoctoral fellow/Research officer/School visitor, Research School of Computer Science, ANU, Australia, 2011–13

• Research Fellow, School of Physical and Mathematical Sciences, Nanyang Technological University, Singapore, 2012

Awards and Achievements

• Awarded, Chemical Society of Thailand Award for Distinguished Contribution to Chemical Education, 2022

• Awarded, Australian Alumni Association (Thailand)'s Alumni Community Engagement Award, 2022

• Awarded, Mahidol Science Innovative Educator Award, 2022

• Awarded, Mahidol University's Honorable mention award for online teaching (media design), 2021 (for the academic year 2020)

• Awarded, Young Scientist Award, Foundation for the Promotion of Science and Technology Under the Patronage of H.M. the King, 2020

• Awarded, MUIC Achievement/Appreciation Award (2016, 2018, 2020) & MUIC Outstanding Faculty Member, 2019

Principal Panel Discussion and Teacher Sharing Session

Principal Panel Discussion & Teacher Sharing Session
Tuesday, February 14th, 2023

Time	Program	Location
13.00-14.00	Principal Panel Discussion	Theater
14.20-16.00	Teacher Sharing Session	Theater & Dr. Kovit Meeting Hall

Principal Panel Discussion

Moderators: Mrs. Parawee Petchsringam and Mr. Tanapat Art Sanguan-Boon

This session aims to discuss the challenges faced by schools regarding the future of education and how to overcome those challenges. The format of this panel is a collaboration-based approach, through which ideas exchange between the panelists and the audience is encouraged via web application platform for engaging participation.

Panelists

Panelist 1: Dr. Worawarong Rakreungdet (Principal of Mahidol Wittayanusorn School, Thailand)
Panelist 2: Mr. Peter Corkill (Principal of John Monash Science School, Australia)
Panelist 3: Mr. Niels Hesselberth (Director of international Activities of St. Odulphuslyceum, The Netherlands)
Panelist 4: Mr. Ervin Santos (Head of Technology Unit, Philippine Science High School – Main Campus, The Philippines)
Panelist 5: Mr. Anthony Douglas (Director of Outdoor Education, Camborne Science and International Academy, The United Kingdom)

Teacher Sharing Session Schedule

Venue 1: Theater
Chairperson: Somporn Buaprathoom and Duangkhae Srikun

Time	Topic	Presenter
14.20-14.40	Multidisciplinary Elective Courses in Chemistry: Enhancing Students' Competencies through Problem-based and Research-Based Learning	Department of Chemistry, Mahidol Wittayanusorn School
14.40-15.00	A Study of the Students' Attitude to English Language Learning through Online Teaching	Metchawin Inthichai
15.00-15.20	Makerspaces in the Context of Student Research Projects: A Case Study	Jason C. Alcarez
15.20-15.40	Blended Learning Experience in Computer Programming Courses	Laokhwan Ngamprasit and Tossaporn Saengja
15.40-16.00	Learning Activity of Workshop Skill Set for Student Innovation Project	Chakrit Samarnrak

Venue 2: Dr. Kovit Meeting Hall
Chairperson: O-Phart Phrathep and Kwansakul Ouppaphan

Time	Topic	Presenter
14.20-14.40	Blended Learning for High-Performing Students	Bernard Ricardo
14.40-15.00	Supplying Tangible Instructional Materials of Natural Sciences to High School Science Students	Jiroat Sangrattanaprasert
15.00-15.20	Trace the History of Evolution in the Classroom	Arbhorn Rubsai
15.20-15.40	"Penname" An Easy Idea to Make Equal Classroom	Tawatchai Sulalai
15.40-16.00	Let's Play Board Games: from a Club Activity to Social Communication	Patsavipich Rungrojtrakool

Multidisciplinary Elective Courses in Chemistry: Enhancing Students' Competencies through Problem-based and Research-Based Learning

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This review focuses on the highlights of teaching and learning activities in several elective courses organized by the Department of Chemistry, Mahidol Wittayanusorn School. The multidisciplinary elective courses in this teacher-sharing work include Analytical Chemistry, Computational Chemistry, Green Chemistry, Industrial Chemistry and Environment, Natural Products, and Polymer Chemistry. Some examples of different types of activities in these courses are as follows; Design and conduct a gravimetric analysis experiment to study factors affecting the size of precipitates before concluding (Analytical Chemistry), Investigate the potential energy surface of an organic molecule (Computational Chemistry), Small-scale Biodiesel synthesis (Green Chemistry), Assessment in Chemical industries and awareness on the environment (Industrial Chemistry and Environment), Sweet project about Chemistry of Chocolate (Natural Products) and Mini-project "How a gel can protect an egg" (Polymer Chemistry). The structure of these elective courses is problem-based and provides students with a research-like activity. Therefore, these courses intend to get students more engaged in research-based activities and apply critical thinking skills to solve problems. From the teacher's observations, the scientific competencies of the students were illustrated as the ability to conduct any tasks effectively as well as critically analyze and interpret results. The student feedbacks about the activities in these elective courses has been overwhelmingly positive. These elective course activities were primarily successful in developing students' competencies and fostering their research skills in multidisciplinary science; as a consequence, it would facilitate the students' attitudes toward higher education and research-oriented careers that can contribute to a knowledge-based society.

Keywords: Elective Courses, Chemistry, Student Competencies, Problem-based Learning, Research-Based Learning

A Study of the Students' Attitude to English Language Learning through Online Teaching

Metchawin Inthichai

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With the Covid-19 pandemic, students and teachers across the world have to adjust ways to study and teach. New things become a common practice in a short time: an online teaching platform is inevitably employed to solve the problem. Sitting in front of the computer for a very long period was what all students were encountering, and this might cause something significant in terms of learning attitudes. Therefore, the purpose of this research was to measure students' attitudes towards learning English through Online Teaching, hoping to find ways to improve this teaching platform. The researcher conducted this research in the first semester of the academic year 2020. The sample group consisted of 28 students studying in grade 11. To do the experiment, the students were asked to take 15 questions, plus 3 open-ended questions. This was done to measure the students' attitudes toward learning English through Online Teaching. Then, the researcher analyzed the scores to find the average score. The findings indicated that the average score of the attitude measurement was 3.52, meaning that the students presented a moderate path to learning English through Online Teaching.

Key words: Attitude, Online Teaching

Makerspaces in the Context of Student Research Projects: A Case Study

Jason C. Alcarez

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Makerspaces or fab labs are creative spaces where clients can use the equipment and expertise available to help them realize ideas. While most makerspaces cater to small businesses and community-centered development, an academic-centered makerspace offers a place where students can work on their projects and collaborate with each other to develop things that bring them joy, while learning design, technical, and collaborative skills needed to operate equipment, execute designs, and explain their work to peers and the public. An immersive ethnographic case study in a Philippine high school presents the various kinds of projects made possible with such a facility and covers challenges and possible directions to take a makerspace for other academic institutions that wish to design a new space or redirect their existing facility are discussed, especially in the points of pricing, time-sharing with other users, and infrastructure considerations.

Keywords: Makerspaces, Fab labs, Secondary schools

Blended Learning Experience in Computer Programming Courses

Laokhwan Ngamprasit* and Tossaporn Saengja

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In the post-pandemic transition, the blended learning approach is applied to the MWIT computer programming courses. In-person settings are used for student-teacher and student-student interactions, whereas online settings are used for student-lesson interactions, allowing them to understand specific concepts and improve their learning at their own pace. In the Python programming course, Replit, an online collaborative IDE used for building software collaboratively on any device without setup, is used. Students can code and do exercises anywhere and anytime from their laptops and mobile devices. In addition, they can collaborate with their classmates, just like they do on Google Docs. This gives students more joy in coding, practicing, and learning. Moreover, it makes grading and handing in programming exercises more effective for students and more efficient for teachers. In the Data Science programming course, checkoff-driven labs are used to encourage students to self-learn materials with teachers as coaches. Although it takes time to construct such worksheets, it can be developed gradually under the same underlying pedagogy. This gives students more opportunities to learn materials at their own pace and realize their academic potential.

Keywords: Blended learning, Programming Course

Learning Activity of Workshop Skill Set for Student Innovation Project

Chakrit Samarnrak

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Some of the basic skill set for student projects or innovation development are electronic skills, workshop-tools skills, CAD skills, 3D printing, and laser cutting. Students seem unable to combine these skills to solve problems. This issue may be a result from teaching each topic separately. Therefore, learning activities allowing students to demonstrate all the skills at the end of the class is vital to their development. The project that was assigned to the student involved making a model boat that could keep the trash off the water. The activity allowed students to only use what they had learned in one month. The boat prototype from teacher was necessary for checking difficulty and making adjustments. It also provided students with insight that let them play an imperfect boat prototype, allowing them to create different ways to solve the problem. In this project, students choose a proper tool for their task and are provided with opportunities to build leadership and teamwork. Most students succeeded in completing the assigned task and could apply the skill set in other projects such as STEM activity or science projects.

Keywords: Teaching Guideline, Workshop Skill Class

Blended Learning for High-Performing Students

Bernard Ricardo

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Active learning, especially for science subjects, is evident from the interactions that happen in the science classroom. Previous studies show how pedagogies emphasizing active learning have helped enhance the students' conceptual understanding of the topics learnt. However, active learning in the classroom takes up precious face-to-face time and often becomes an issue as teachers are obliged to complete the content within the given curriculum time. When it comes to high-performing students, a blended approach with pre- and post-lesson videos to complement active learning in the classroom would help create the additional time required. Blended learning (BL), or the integration of face-to-face and online instruction, is widely adopted across higher education with some scholars referring to it as the "new traditional model" or the "new normal" in course delivery. The face-to-face time in the classroom may then be used to facilitate scientific discussions and enhance dialogic teaching and learning processes. The author has experimented with blended learning even before the COVID-19 pandemic period and its usefulness extends to the current post-pandemic teaching and learning. The author has also collated a few comments from the students through an interview. The remarks show that this pedagogy is deemed to be suitable for high-performing students and it is an approach preferred by students and educators alike.

Keywords: Active learning, Blended learning, High-performing, Flipped, Lightboarding

Supplying Tangible Instructional Materials of Natural Sciences to High School Science Students

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Human beings are part of nature. We cannot live comfortably without ecosystem services, e.g., food, fresh water, and clean air. Nowadays, as we are creating, inventing, and developing high technology for our well-being; unfortunately, diversities of the natures among us are being destroyed and disturbed unwittingly by human activities. Habitats of other creatures living in forest, as well as under fresh water and sea, are destroyed continuously. Extinction of many species caused by losing habitats, in return, has made quite a great impact on ecological balance and human livelihood. Thus, inspiring and instilling our students with an increasing awareness of the importance of the nature are urgently needed. However, teaching natural sciences to engage the students in the classroom is not easy. Specimens required for each lesson shall necessarily be supplied to the students so that they all can have such hands-on experience. The fresh specimens of organisms are still attractive for the biological classroom due to both fresh and intact characteristics of some organisms, which may soon disappear after having reacted with fixing agents, i.e., colours, transparency, scents etc. Accordingly, in order to mitigate and ameliorate these concerns, we have allotted some area to build a small botanical garden, where many bryophytes, ferns, and tropical plants have been grown and a lot of trees around the school have also been planted to serve as tangible instructional materials, which are required in a wide variety of basic and elective courses we offer. In addition, naturalists and scientists working on ecology and taxonomy are invited to give a talk on their works to MWIT students frequently. These have effectively sparked some interest in the students to work deeply on natural science projects, as well as broadening their horizons so that they may travel the world in pursuit of their deeper knowledge. Some of their works got awards from Thai and International academic conferences and published in science journals.

Keywords: Naturalist, Botanical garden, Biological course

Trace the History of Evolution in the Classroom

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How to teach evolutionary content about the history of evolution in an interesting way? What should we choose movies, documentaries, or any other good teaching materials that are available today. In organizing the learning process, emphasis on explaining the various theories of evolution data with supporting evidence. In classroom, start with checking the understanding by jointly discussing living things in the present, how it evolved? Why still different? Will the future change again? What the factor of changing? And the first room students draw a picture of an important time line of evolution beings gained from the discussion between teachers and students on the study desk (which can be erased using an eraser and does not damage the school desk) and able to add more information, draw pictures from additional research. Next classroom, the teacher won't say anything about the picture on the study desk. And teach with the same technic as the first room students. There were some students who noticed what their friends drew and left a mark on the table. The information drawn by friends may or may not be on the issues that have been discussions. Some classrooms may present new issues or traces drawn by friends may fade. There will be add more information or complete it. The result is the classroom became more lively. Drawing on the desk, it’s unbelievable that using such a simple method, no special equipment can create enthusiasm of student for note-taking and find better answers and leads to interesting content in the next lesson.

Keywords: Evolution, Trace, Study desk

“Penname” An Easy Idea to Make Equal Classroom

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Penname is used by writers to convey their feelings, symbolic meanings and ideas that they want to show to reader instead of their real name. Teachers can use this technique to let students stay anonymous behind their penname throughout the semester. Then they can criticize, give feedback and comment to each other’s work without making direct retaliation. Penname also lets teachers join in class anonymously and also lets us improve ourselves by doing the same work as the students. So, the students will feel equal in classroom and feel relaxed and work more freely without trying to limit themselves to satisfy the teacher since they do not know who is criticizing their work. The result showed that students preferred this method of teaching as they exchanged their opinions to improve their work. Also, since we used online platforms to communicate and connect to each other, they even helped others by reading and commenting outside classroom. This is how teachers can be learners as well. Since we can narrow the age and generation gap that separates us from our student, this is the starting point for a truly equal classroom.

Keywords: Penname, Classroom management, Teaching method

Let's Play Board Games: from a Club Activity to Social Communication

Patsavipich Rungrojtrakool

Mahidol Wittayanusorn School, Nakhon Pathom, 73170, Thailand

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Board games are games that link people together through various tasks and activities. There are several categories of board games: party games, family games, and strategy games. People usually play board games as a hobby or as group activities. We use them in our club activity (Let's play board games). During the club period, we talk and discuss as well as share ideas and experiences. In September 2022, Lanlalen, a board game cafe, sent us a letter to demonstrate a roadshow for two new games of MWIT school for the first national competition of board games in Thailand. The 'Lanlalen' team asked us to join Thailand Youth Board Game Championship (TYBC 2022). In our first step, two teams represented MWIT at TYBC 2022, and team planning and self-practice were the following steps. As a teacher, the major expectation in this competition was a chance to develop interpersonal skills and critical thinking in practice. Fortunately, our teams passed to semi-final round, and one of us won the first prize. The most memorable step was gaining new friends, being more opened-minded, and building self-esteem.

Keywords: Board games, Student activity, TYBC

Student Project Poster Presentation
Monday, February 13th, 2023

Project code	Project name	School	Presenter(s)
Collaborative Project			
MN-01	The optimisation of growth of microgreens and the development of fruit and microgreens smoothies for elders based on antioxidant capacity and sensory evaluation	National Junior College, Singapore Mahidol Wittayanusorn School, Thailand	Hui Wen How Karthickraj Dhanyashri Passavee Losripat Jatupat Jarupokawat Jirachaya Petchprasit
MN-02	Synthesis and application of carbon dots	National Junior College, Singapore Mahidol Wittayanusorn School, Thailand	Aaryan Aggarwal Nagar Jayani Atul Thania Del Radovan Lofranco Natdanai Sakdapipanich Thananun Sungprasert Chisa Pechkhajee
MN-03	The begetting of Learn Unlearn Relearn (LUR) Model through subject and skill based comparative studies	National Junior College, Singapore Mahidol Wittayanusorn School, Thailand	Aida Cempaka Hanif Tanay Jay Nair Chinata Kanjanarujvivat Natchapon Worakhunpiset
MN-04	Examining the effect of artificial intelligence on social conformity between adolescents	National Junior College, Singapore Mahidol Wittayanusorn School, Thailand	Zo Ey Phua Natthapat Ratthanarak
Online Participation			
BI-04	Mycelium and stubble substrate brick construction and analysis under varying conditions with regression models and machine learning	The Vasant Valley School, India	Ritwick Sapra Shashvat Rastogi Vivasvat Rastogi
BI-25	To investigate the physiological function of kinesin Kif19A in the olfactory and taste systems of *Drosophila melanogaster*	Experimental School of BeiHang University,China	Ailin Zhong
BI-26	The population of rove beetles in various biocenoses of the Smolensk region	Advanced Education and Science Center of Moscow State University (The Kolmogorov School), Russia	Daria Senina
CH-04	Preparation and applications of mud microbial fuel cells	Tokyo Tech High School of Science and Technology, Japan	Honoka Umeda Sachina Watanuki

Project code	Project name	School	Presenter(s)
CH-13	Development of tri-layer heterostructures for large spin-orbit interaction	Anglo-Chinese School (Independent), Singapore	Dillon Josh Tan Joshua Kay Jian Chen
CH-15	CARBOXAN: ZnONP loaded carboxymethylcellulose/chitosan (CMC-CS) nanocomposite solution from Azolla and Philippine Diadema savignyi (Blue-Eyed Sea Urchin) as novel coating material for banana fruit	Bansud National High School – Mimaropa Regional Science High School, Philippines	Nikko Lemon Mariano Jesusa Grace Calingasan Shea Fiedalino
CO-11	The high-voltage tower climbing robot	Experimental School of BeiHang University, China	Sizhuo Zhang
PH-03	How can muscle signals be used to control other devices?	John Monash Science School, Australia	Puneet Ram Badireddi
PH-05	Light pollution creates background noise which prevents the ability to see faint objects	Australian Science & Mathematics School, Australia	Eliza Grivell
PH-11	Supernovae type Ia and cosmic distance measurement	Manzoumeh Kherad Institute, Iran	Dorsa Alizadeh Otaghvar Kimia Koneshlou
Presentation Time: 14:00 - 15:20 hrs.			
BI-01	Effects of ethinyl estradiol (EE2) on the male and female ratio of small freshwater shrimp, "*Paratya compressa*"	Waseda University Honjo Senior High School, Japan	Akari Taniguchi Yui Sasaki Mariko Nakajima
BI-03	Effect of population density on burrow characteristics in the fiddler crab (*Uca bengal*i)	Princess Chulabhorn Science High School Trang, Thailand	Chatcharin Janddee Siorn Leekpai
BI-05	Innovative of plastic nanofiber from polyvinyl alcohol for plant tissue culture	Princess Chulabhorn Science high school Mukdahun, Thailand	Jiranan Sarapat Kamonphat Akkapacha Nicharat Thiralakkhanaphat
BI-07	Prediction and screening of anticancer peptides against melanoma cells and to reduce melanin synthesis from the peptides of *Cannabis sativa* seed using bioinformatics techniques	Mahidol Wittayanusorn School, Thailand	Suttithan Suwannoppakun Chuthamas Rattanapongvanich Preechaya Naraprasertkul
BI-09	Can the construction of Oarweed, *Laminaria Digitata* and Marram grass, *Ammophila* into an organic fishing net, provide a natural sustainable alternative to the unsustainable traditional fishing nets made from plastics?	Camborne Science and International Academy, United Kingdom	Freya Gillson Jessica Nicoll Ethan Hancock
BI-11	Development of ant-repellent gel from stevia leaf extract and enhanced with calcium hydroxide from egg shells	Princess Chulabhorn Science High School Loei, Thailand	Ainglada Thonghaw Chanthakan Thongaram Siriyakorn Khunchuen

Project code	Project name	School	Presenter(s)
BI-13	The migration pattern and possible movement of breeding grounds of the endangered oceanic whitetip shark, *Carcharhinus longimanus* in response to increasing global temperatures	Camborne Science and International Academy, United Kingdom	Ugne Barasaite Ali Abusara
BI-15	Curcumin-loaded nanocomplexes alleviates acute kidney injury in hamsters-induced by Adenine	Demonstration School of Khon Kaen University, Secondary (Suksasart), Thailand	Chawanluk Ruangchayajatuporn Yada Pratipanawatr
BI-17	Epigenetics in the future	St. Odulphuslyceum, Netherlands	Afke van Dijk Doae El Geunnouni
BI-19	Screening of Thai red holy basil cultivars for a nutraceutical by bioactive and Eugenol synthase gene expression analysis	Kasetsart University Laboratory School Kamphaeng Saen Campus, Thailand	Nutjirapat Jiraphimukkul Ratchakarn Chandon Kusalin Somritchinda
BI-21	Screening of aerobic fibrolytic microorganisms for glucose production from waste paper	Princess Chulabhorn Science High Scool Lopburi, Thailand	Chonticha Permrungruang Prapawan Ponintra
BI-23	The influences of pH on flower protoplasm	Ritsumeikan High School, Japan	Nanako Ifuku
CH-02	Synthesis of carbon dots from pomelo peel for fingerprint detection	Mahidol Wittayanusorn School, Thailand	Natdanai Sakdapipanich Thananun Sungprasert Chisa Pechkhajee
CH-06	The carbon dioxide converting incinerator	New Generation School Preah Sisowath High School, Cambodia	Ly Kulapati In Empiseysocheata
CH-08	Release rate of caffeine drug delivery with functionalized UiO-66	Korea Science Academy of KAIST, Korea	Jimin Kong Jungwoo Kim
CH-10	Analyzing the contributions of microbial food production technology to the future food crisis	Hana Academy Seoul, Korea	Chan Yong Shim Jimin Shin Seoyeon Kim
CH-12	Synthesis of DNA-binding thiazolopyrimidine systems containing dimethylaminostyryl substituents as fluorescent molecular probes	Moscow South-Eastern School named after V.I. Chuikov, Russia	Danil Rakitianskii
CH-14	Optimization of ultrasound-assisted extraction for *nelumbo nucifera* petals and its antioxidant activity	Demonstration School of Khon Kaen University, Secondary Level (Mo din daeng), Thailand	Yodsakorn Kornsopa Yada Sittibodeekul
CH-17	Development of bioplastics from starch for indicating spoilage of food	Mahidol Wittayanusorn School, Thailand	Karnpichcha Samutkodom Kittipan Boonchaithanin Chayanun Charoensungnoen

Project code	Project name	School	Presenter(s)
CO-01	Comparison of the temperature distribution in human eye during treatment with IPL and Laser techniques: Numerical simulation	Mechatronics Department (KOSEN-KMITL)	Tapanon Maisuk Kanta Patan Promporn Wutthipipattanapong
CO-03	Development of a neural network for classifying selected fabaceae family plant leaves	Philippine Science High School – Main Campus, Philippines	Marco Raphael Liceralde Michael Jeffrey Real Sidney Lance Fernando
CO-05	Negative Filter: browser plugin for Thai twitter sentiment analysis	Mahidol Wittayanusorn School, Thailand	Nattgarni Aphimookkul
CO-07	Developing application for predicting COVID-19 infection from chest X-ray images using deep learning techniques	Demonstration School Prince of Songkla University, Thailand	Awera Ruampornpanu Finik Palaray
CO-09	Life jacket wearing detection system for safety water transportation using deep learning technology	Mahidol Wittayanusorn School, Thailand	Titat Uttawat Jeeranut Songsri
LA-02	Examining the effect of AI on social conformity between adolescents	National Junior College, Singapore	Zo Ey Phua
LA-04	Conformity between human and artificial intelligence the effect of AI on human decision-making to the effect of humans on human decision-making in teenagers aged between 15 - 17 years old	Mahidol Wittayanusorn School, Thailand	Natthapat Ratthanarak
LA-06	3D model of water pollution	New Generation School Preah Sisowath High School, Cambodia	Neth Chan Tepy
PH-01	A Bicycle that minimizes counter-steering	Seoul Science High School, Korea	Ahn Jun-Hyuk Lee Sion Jwa Hee-ju
PH-04	Effect of the planetary magnetic field on the shape of gas giants' polygons based on fluid instabilities principle	Kamnoetvidya Science Academy, Thailand	Pavarit Phanichkul Amada Panumonwatee Jinjuta Paripurana
PH-06	Diagnosis of hearing disease using pairs of auditory illusion words	Mahidol Wittayanusorn School, Thailand	Suramit Boonsom Rujipart Thamwirotsiri
PH-08	Agricultural drone	Vientiane Secondary School, Lao P.D.R.	Khemmany Vilayvong Pakasith Sitthivong Phoutthachack Somsy
PH-10	The study of dynamics of falling Mahogany *Swietenia macrophylla* seeds for the development of guidelines for helping victims of flood	Princess Chulabhorn Science High Schools Pathum Thani, Thailand	Aekkorn Panbangna Chitipat Kongtongvattana Supakorn Kajornkiatnukul
PH-13	Classification of the ripeness stage of ‘Nam Dork Mai’ mango using density value and 3D object volume approximation	Princess Chulabhorn Science High School Phetchaburi, Thailand	Jaturapat Anusornpanich Jarukarn kitjaruwong

Project code	Project name	School	Presenter(s)
Presentation Time: 15:40 - 17.00 hrs.			
BI-02	Genotype-phenotype assessment of variants of uncertain significance (VUS) in SCN5A Gene with human stem cell-derived cardiomyocytes	National University of Singapore High School of Math & Science, Singapore	Colin Chow Kah Ler Justin Au Heng Yee Khan Mohamed Dhasil
BI-06	Development of edible coating from *Gracilaria fisheri* and tannin of banana peel extracts for extending shelf life of 'Nam Dok Mai' mango fruit	PSU.Wittayanusorn Surat Thani School, Thailand	Waritsara Nateetorn Witsuta Noosing
BI-08	Photosynthesis of medical cannabis plant	Demonstration School University of Phayao, Thailand	Waratthaya Thanakanthat Kittima Takam Suphadcha Somkhuan
BI-10	Antioxidant power of red, green and yellow bell peppers (*Capsicum annuum*)	G.T. (Ellen Yeung) College, Hong Kong	Hayden Lam Man Hin Tse Hei Man Chan
BI-12	Mode of action of antibacterial activity of Galangin plus Vancomycin against drug resistant bacteria	Surawiwat School, Suranaree University of Technology, Thailand	Khwanmanat Uttapa Kwanrada Kurusateian Paphawee Jirapanjawat
BI-14	Olfactory influences on behavior in *Drosophila*	Ritsumeikan High School, Japan	Fusako Tanio
BI-16	The study of red and yellow shades from local plants	Mahidol Wittayanusorn School, Thailand	Tanatchaya Sunpet Kawalin Klugwong Apisara Kawikul
BI-18	Antifungal and antibiofilm activity of denture soft liner incorporated with ethanol extract of *Melastoma malabathricum* leaf	Islamic Sciences Demonstration School, Prince of Songkla University, Thailand	Arnas Naengdam Nada Beraheng
BI-20	The effect of aposymbiotic Aiptasia on its venom composition	The Leo Baeck Education Center, Israel	Danielle Sigal Michal Goldeshtein Roni Forkosh Sheyna Girshovich
BI-22	The pollination biology of *Balanophora latisepala* (Tiegh.) Lecomte in Thailand	Mahidol Wittayanusorn School, Thailand	Nithit Chaiwerawattana
BI-24	Optimisation of growth of microgreens by varying seed density and growing medium	National Junior College, Singapore	Hui Wen How Karthickraj Dhanyashri
CH-01	Evaluation of the effectiveness and relevance of the different methods of synthesis of carbon dots on fingerprint detection	National Junior College, Singapore	Aaryan Aggarwal, Nagar Jayani Atul Thania Del Radovan Lofranco

Project code	Project name	School	Presenter(s)
CH-03	Magnetic nanoparticles decorated titanium dioxide nanocylinders for cancer therapeutic delivery	Lukhamhan Warinchamrab School, Thailand	Kanyarat Promkong
CH-05	Sawasdee-AMP: Highly efficient, portable and low-cost point of care test kit for future emerging RNA/DNA disease diagnosis	Mahidol Wittayanusorn School, Thailand	Kulpatch Chananam Pakitta Kriangasame Kunat Khongtong
CH-07	The development of fruit and microgreens smoothies for elders based on antioxidant capacity and sensory evaluation	Mahidol Wittayanusorn School, Thailand	Passavee Losripat Jatupat Jarupokawat Jirachaya Petchprasit
CH-09	An indicator biofilm for meat product freshness synthesized from sugarcane bagasse with anthocyanin (extracted) by *Hibiscus sabdariffa*	Princess Chulabhorn Science High School Phitsanulok, Thailand	Jidapa Khanthong Kanyarat Chaisui Kulpriya Masan
CH-11	The development of shampoo containing phenolic compounds from cashew apple to slow down grey hair process	Mahidol Wittayanusorn School, Thailand	Pakwan Boonprakaikaew Pabhada Charoensit Bua Chantharangsikun
CH-16	Development and synthesis of B-group provitamins capable of passing through the cell membrane in case of SLC5A6 gene mutation	Moscow South-Eastern School named after V.I. Chuikov, Russia	Alexander Migulin
CO-02	A study of supervised learning for human pose classification with 3D skeleton model	Mahidol Wittayanusorn School, Thailand	Pathomphu Kanapornthada
CO-04	Diagnosis application for Parkinson's disease by hand tremor analysis	Mahidol Wittayanusorn School, Thailand	Boonyavee Wiriyawongwan Nassawan Rungrittidech
CO-06	The Development of artificial intelligence system to detect *Mycobacterium Tuberculosis* (*M. Tuberculosis*) from sputum with Acid-Fast Bacillus (AFB) method	Princess Chulabhorn Science High School Chonburi, Thailand	Peraga Puangtong Punnathorn Khunhon
CO-08	Making Thai script inclusive: universal Thai font	Triam Udom Suksa School, Thailand	Patiparn Sittinisaisuk
CO-10	The extension of the assignment problem and its solution	Senior High School at Komaba, University of Tsukuba, Japan	Seiji Hirata
CO-12	iSupskin, artificial intelligence program for CNN-image classify	Princess Chulabhorn Science High School Satun, Thailand	Panrapee Pandum Natsinee Ruengsiri
CO-13	AI-based hazardous materials sign detection for rapidly manufacturer rescue robot	Engineering Science Classroom (KOSEN - KMUTT)	Teerut Tangsiripinyo Nattavee Sunitsakul Wiwan Wijitworawong
LA-01	Thai traditional music composition using long short-term memory network	Mahidol Wittayanusorn School, Thailand	Phakin Teerawatthanaprapha Peerapat Laoveerathum

Project code	Project name	School	Presenter(s)
LA-03	A comparative study of three forms of learning media (videos, short articles, and infographics) on their effectiveness in helping high school students to 'rethink'	Mahidol Wittayanusorn School, Thailand	Chinata Kanjanarujvivat Natchapon Worakhunpiset
LA-05	Derivation of a concrete learn unlearn relearn framework by using cooking as a case study	National Junior College, Singapore	Aida Cempaka Hanif Tanay Jay Nair
MA-01	A natural extention of 3D catalan numbers	Seoul Science High School, Korea	Donggeon Kim Dongjoo Suh Woojin Kim
PH-02	The study of the correlation between shade with the surface tension and buoyant force of water strider' movement on the water surface	Princess Chulabhorn Science High School Buriram, Thailand	Apsara Reiter Metawe Mantummongkol
PH-07	Heavy metal (Zinc) measurement machine in RGB color systems with chelate rutin	Princess Chulabhorn Science High School Nakhon Si Thammarat, Thailand	Kantapong Rukpong Kritsanaphong Kaeomueang
PH-09	The process of biotechnical product development with the example: resistance clothing	St. Odulphuslyceum, Netherlands	Enes Sunkur Wei Jie Chen
PH-12	Trial of power generation using river sludge	Waseda University Honjo Senior High School, Japan	Ryotaro Katsumata Chitose Shindoh Kanako Utsumi

Student Project Oral Presentation Schedule
Tuesday, February 14th, 2023

Venue 1: Theater

Committees:

1) Assoc. Prof. Dr.Ekaphan Kraichak, Kasetsart University, Thailand
2) Dr. Itthipol Sungwienwong, Srinakharinwirot University, Thailand
3) Dr. Petchara Pattarakijwanich, Mahidol University, Thailand

Time	Project code	Project Title	School	Presenter(s)
08.30 – 08.50	CO-12	iSupskin, artificial intelligence program for CNN-image classify	Princess Chulabhorn Science High School Satun, Thailand	Panrapee Pandum Natsinee Ruengsiri
08.55 – 09.15	BI-18	Antifungal and antibiofilm activity of denture soft liner incorporated with ethanol extract of *Melastoma malabathricum* leaf	Islamic Sciences Demonstration School, Prince of Songkla University, Thailand	Arnas Naengdam Nada Beraheng
09.20 – 09.40	CH-02	Synthesis of carbon dots from pomelo peel for fingerprint detection	Mahidol Wittayanusorn School, Thailand	Natdanai Sakdapipanich Thananun Sungprasert Chisa Pechkhajee
09.45 – 10.05	PH-07	Heavy metal (Zinc) measurement machine in RGB color systems with chelate rutin	Princess Chulabhorn Science High School Nakhon Si Thammarat, Thailand	Kantapong Rukpong Kritsanaphong Kaeomueang
10.05 – 10.20	Break			
10.20 – 10.40	BI-07	Prediction and screening of anticancer peptides against melanoma cells and to reduce melanin synthesis from the peptides of *Cannabis sativa* seed using bioinformatics techniques	Mahidol Wittayanusorn School, Thailand	Suttithan Suwannoppakun Chuthamas Rattanapongvanich Preechaya Naraprasertkul
10.45 – 11.05	CO-11 **online**	The high-voltage tower climbing robot	Experimental School of BeiHang University, China	Sizhuo Zhang
11.10 – 11.30	CH-04 **online**	Preparation and applications of mud microbial fuel cells	Tokyo Tech High School of Science and Technology, Japan	Honoka Umeda Sachina Watanuki
11.35 – 11.55	BI-04 **online**	Mycelium and stubble substrate brick construction and analysis under varying conditions with regression models and machine learning	Vasant Valley School, India	Ritwick Sapra Shashvat Rastogi Vivasvat Rastogi

Venue 2: Dr. Kovit Meeting Hall

Committees:

1) Assoc. Prof. Dr.Weekit Sirisaksoontorn, Kasetsart University, Thailand
2) Dr. Tatpong Tulyananda, Mahidol University, Thailand
3) Dr. Rungroj Jintamethasawat, National Electronics and Computer Technology Center (NECTEC), Thailand

Time	Project code	Project Title	School	Presenter(s)
08.30 – 08.50	BI-02	Genotype-phenotype assessment of variants of uncertain significance (VUS) in SCN5A Gene with human stem cell-derived cardiomyocytes	National University of Singapore High School of Math & Science, Singapore	Colin Chow Kah Ler Justin Au Heng Yee Khan Mohamed Dhasil
08.55 – 09.15	LA-01	Thai traditional music composition using long short-term memory network	Mahidol Wittayanusorn School, Thailand	Phakin Teerawatthanaprapha Peerapat Laoveerathum
09.20 – 09.40	CH-12	Synthesis of DNA-binding thiazolopyrimidine systems containing dimethylaminostyryl substituents as fluorescent molecular probes	Moscow South-Eastern School named after V.I. Chuikov, Russia	Danil Rakitianskii
09.45 – 10.05	CO-06	The development of artificial intelligence system to detect *Mycobacterium Tuberculosis* (*M. Tuberculosis*) from sputum with Acid-Fast Bacillus (AFB) method	Princess Chulabhorn Science High School Chonburi, Thailand	Peraga Puangtong Punnathorn Khunhon
10.05 – 10.20	Break			
10.20 – 10.40	PH-09	The process of biotechnical product development with the example: resistance clothing	St. Odulphuslyceum, Netherlands	Enes Sunkur Wei Jie Chen
10.45 – 11.05	BI-15	Curcumin-loaded nanocomplexes alleviates acute kidney injury in hamsters-induced by Adenine	Demonstration School of Khon Kaen University, Secondary (Suksasart), Thailand	Chawanluk Ruangchayajatuporn Yada Pratipanawatr
11.10 – 11.30	CO-02	A study of supervised learning for human pose classification with 3D skeleton model	Mahidol Wittayanusorn School, Thailand	Pathomphu Kanapornthada
11.35 – 11.55	CH-03	Magnetic nanoparticles decorated titanium dioxide nanocylinders for cancer therapeutic delivery	Lukhamhan Warinchamrab School, Thailand	Kanyarat Promkong

Venue 3: Dr. Nat Meeting Hall

Committees:

1) Assoc. Prof. Dr. Kittiwit Matan, Mahidol University, Thailand
2) Asst. Prof. Dr. Nawaporn Vinayavekhin, Chulalongkorn University, Thailand
3) Dr. Soontorn Sirapaisan, National Electronics and Computer Technology Center (NECTEC), Thailand

Time	Project code	Project Title	School	Presenter(s)
08.30 – 08.50	CH-07	The development of fruit and microgreens smoothies for elders based on antioxidant capacity and sensory evaluation	Mahidol Wittayanusorn School, Thailand	Passavee Losripat Jatupat Jarupokawat Jirachaya Petchprasit
08.55 – 09.15	BI-09	Can the construction of Oarweed, Laminaria Digitata and Marram grass, Ammophila into an organic fishing net, provide a natural sustainable alternative to the unsustainable traditional fishing nets made from plastics?	Camborne Science and International Academy, United Kingdom	Freya Gillson Jessica Nicoll Ethan Hancock
09.20 – 09.40	CO-07	Developing application for predicting COVID-19 infection from chest X-ray images using deep learning techniques	Demonstration School Prince of Songkla University, Thailand	Awera Ruampornpanu Finik Palaray
09.45 – 10.05	PH-12	Trial of power generation using river sludge	Waseda University Honjo Senior High School, Japan	Ryotaro Katsumata Chitose Shindoh Kanako Utsumi
10.05 – 10.20	Break			
10.20 – 10.40	LA-02	Examining the effect of AI on social conformity between adolescents	National Junior College, Singapore	Zo Ey Phua
10.45 – 11.05	BI-03	Effect of population density on burrow characteristics in the fiddler crab (*Uca bengali*)	Princess Chulabhorn Science High School Trang, Thailand	Chatcharin Janddee Siorn Leekpai
11.10 – 11.30	CH-16	Development and synthesis of B-group provitamins capable of passing through the cell membrane in case of SLC5A6 gene mutation	Moscow South-Eastern School named after V.I. Chuikov, Russia	Alexander Migulin
11.35 – 11.55	CO-04	Diagnosis application for Parkinson’s disease by hand tremor analysis	Mahidol Wittayanusorn School, Thailand	Boonyavee Wiriyawongwan Nassawan Rungrittidech

Venue 4: Room 1303 (for online presenters)

Commentators:

1) Mr. Romnick Ureta ,Bansud National High School – Mimaropa Regional Science High School, Phillipines
2) Dr. Vincent YK Tam, G.T. (Ellen Yeung) College, Hong Kong
3) Mr. Anucha Pratumma, Mahidol Wittayanusorn School, Thailand

Time	Project code	Project Title	School	Presenter(s)
08.30 – 08.50	PH-05	Light pollution creates background noise which prevents the ability to see faint objects	Australian Science & Mathematics School, Australia	Eliza Grivell
08.55 – 09.15	CH-15	CARBOXAN: ZnONP loaded carboxymethylcellulose/ chitosan (CMC-CS) nanocomposite solution from Azolla and Philippine Diadema savignyi (blue-eyed sea urchin) as novel coating material for banana fruit	Bansud National High School – Mimaropa Regional Science High School, Philippines	Nikko Lemon Mariano Jesusa Grace Calingasan Shea Fiedalino
09.20 – 09.40	PH-03	How can muscle signals be used to control other devices?	John Monash Science School, Australia	Puneet Ram Badireddi
09.45 – 10.05	BI-25	To investigate the physiological function of kinesin Kif19A in the olfactory and taste systems of *Drosophila melanogaster*	Experimental School of BeiHang University,China	Ailin Zhong
10.05 – 10.20	Break			
10.20 – 10.40	CH-13	Development of tri-layer heterostructures for large spin-orbit interaction	Anglo-Chinese School (Independent), Singapore	Dillon Josh Tan Joshua Kay Jian Chen
10.45 – 11.05	PH-11	Supernovae type Ia and cosmic distance measurement	Manzoumeh Kherad Institute, Iran	Dorsa Alizadeh Otaghvar Kimia Koneshlou
11.10 – 11.30	BI-26	The population of rove beetles in various biocenoses of the Smolensk region	Advanced Education and Science Center of Moscow State University (The Kolmogorov School), Russia	Daria Senina

Student Project Abstracts

Biology

BI-01

Effects of Ethinyl Estradiol (EE2) on the male and female ratio of small freshwater shrimp, "*Paratya compressa*"

Akari Taniguchi, Yui Sasaki, Mariko Nakajima & Toru Handa

Waseda University Honjo Senior High School, Honjo, Saitama, 367-0032 Japan
Correspondence should be addressed to A.T. (733.dragon@fuji.waseda.jp)

[Background]

Since 2015, we have continued research on Koyama River in Honjo city and its pollution situation in small freshwater shrimp caused by the non-native species to study the difference in vitality between native species and non-native species. In the process, there is a big contrast between male and female ratio of the non-native species depending on the point of investigation.

[Purpose of the project]

When investigating the pollution status of a river, trash can be seen with the naked eye, and elements of water quality such as pH and DO can be measured relatively easily. However, measuring environmental hormones requires expensive chemicals and equipment, making it extremely difficult to conduct surveys. We are wondering if it is possible to use river shrimp as a barometer of environmental hormone concentrations without measuring environmental hormones chemically.

[Methodology]

We predicted that the factor are environmental hormones and examined the concentration of ethinyl estradiol (EE2), a synthetic follicle hormone that is relatively easy to analyze.

Since the site known as Senbonzakura in particular has a higher proportion of females than other sites, we decided to investigate the relationship between EE2 concentrations and sex ratios.

[Results of the study]

Higher concentrations of EE2 at sites with higher proportions of females would be expected to correlate However, due to the difficulty of measuring EE2, it is not yet possible to draw conclusions.

[Conclusion]

It would seem that the ratio of male to female river shrimp could be used as a barometer of environmental hormone concentrations.

[Future study plan]

Since numerous surveys of shrimp male to female ratios have been ongoing over the years, we do not see a problem with the amount of data. However, measuring EE2 concentrations is not easy, making it difficult to increase the amount of data.

Also, if EE2 is influencing the sex determination of shrimp, it is necessary to investigate at which stage of shrimp growth it is influencing.

[Keywords]
Shrimp, EE2, Environmental hormone

BI-02

Genotype-phenotype assessment of variants of uncertain significance (VUS) in SCN5A Gene with human stem cell-derived cardiomyocytes

Justin Heng Yee Au, Khan Mohamed Dhasil, Colin Kah Ler Chow & Poh Loong Soong

NUS High School of Math and Science, Singapore, 129959, Singapore
Correspondence should be addressed to J.H.Y.A. (h1810008@nushigh.edu.sg)

[Background]

Cardiovascular diseases and disorders are the leading cause of death globally. However, much of the underlying mechanisms remain unknown, with the lack of knowledge proving to be a major obstacle in the development of cures and treatments.

Among these disorders is the Brugada Syndrome. Capable of causing irregular heartbeats to manifest which significantly reduces blood flow to the brain, affected patients may suffer long-lasting brain damage and even death. As such, patients with this disease have an average life expectancy of 40 years. Arising from a mutation in the SCN5A gene, which codes for the cardiac voltage-gated sodium channel. The channel plays a part in regulating the action of contractile cells in the heart. Impairment of Na+ influx due to this loss-of-function mutation impairs the heart's ability to conduct electrical impulses. In turn, irregular heartbeats may arise.

Despite being highly prevalent in Southeast Asia, advances in drug development are hampered by the lack of studies into the mutation, due to strict ethical restrictions and identification of affiliated people. This is evident in the fact that 80% of SCN5A mutations are classified as a Variant of Uncertain Significance, or VUS in short.

[Purpose of the project]

Addressing the issue of collecting cardiac cells to study, which is often time-consuming and fraught with ethical reviews, our project aims to develop a platform for rapid analysis of SCN5A mutations whose significance to the function or health of an organism is still unknown.

Therefore, our research investigates the main SCN5A variants that can be found in Singapore's population, which have yet to be studied and determine their phenotypic significance. This would allow us to identify high-risk groups of certain syndromes within our population, hence providing an opportunity for early interventions and precautionary measures to be taken.

[Methodology]

The first stage of our methodology consists of the preparation of stem cell-derived cardiomyocytes. After obtaining blood samples from different individuals in Singapore, Yamanaka reprogramming factors are introduced into the blood cells to induce pluripotency. We would then proceed to optimize cell count to prevent excessive cell death while ensuring tissue integrity. After performing the differentiation in plates with different numbers of cells, we determined a cell count of 800 000 is ideal.

Stained hIPSCs-specific protein antibodies (such as Anti-TRA-1-60-PE, CD15-PE-Vio770, Anti-SSEA-4-VioGreen, Anti-SSEA-5-VioBlue, Anti-Sox2-FITC, Anti-Oct3/4 Isoform A-APC) are introduced to the culture hISPCs, allowing multi-coloured flow cytometry to be conducted to verify the pluripotency of the hIPSCs. The same procedure is then repeated to verify the differentiated cardiomyocytes.

The next phase of our methodology would be to introduce the mutant SCN5A gene into the stem cell-derived cardiomyocytes. Firstly, PCR is used to amplify the target mutant SCN5A gene. Afterwards, a newly developed CRISPR technique, prime editing, is used to insert the mutant gene into our stem cell-derived cardiomyocytes.

Afterwards, q-PCR is used to verify whether the mutant gene is inserted correctly into the cardiomyocytes. Morphological testing is conducted on the successful recombinant cardiomyocytes to determine the phenotypic significance of the mutant gene, hence characterizing the variant of uncertain significance.

[Results of the study]

As we are still amid experimentation, these are the preliminary results we have obtained.

Furthermore, the results of our multi-coloured flow cytometry are consistent with the results of photomicroscopy. As you can see from these graphs, there are high concentrations of cells that have been positively stained with the hIPSCs-specific antibodies, indicating a high level of pluripotency, hence we can proceed to the next phase of our experimentation.

[Conclusion]

NIL as experimentation is still ongoing.

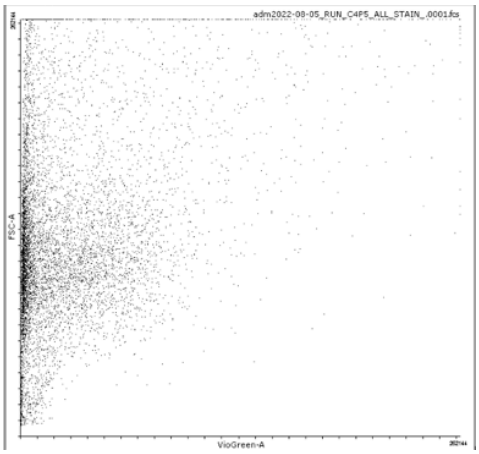
[Future study plan]

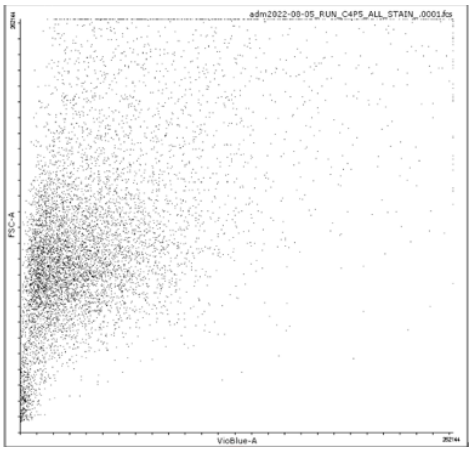
Further studies can be done on other VUSs, allowing us to determine the different types of mutations that lead to the Brugada Syndrome. This would allow us to develop a more comprehensive treatment method targeting Brugada Syndrome, hence reducing the mortality due to Brugada Syndrome.

This type of testing platform can also be exported to different cardiomyocyte-related diseases

[Keywords]

SCN5A, Variants of Uncertain Significance, hIPSCs, Prime Editing,





BI-03

Effect of population density on burrow characteristics in the fiddler crab (*Uca Bengali*)

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[Background]

In Thailand, there were about 2400 million square meters of the mangrove forest. In Trang province, southern Thailand there were about 320 million square meters and in Ban Modtanoi, Kantang, Trang Province, there were 4.8 million square meters of the mangrove forest which is for equal about 0.2% of the mangrove forest in Thailand. Nowadays mangrove forests have been diminished at alarming rates due to human exploitation. Fiddler crab is a crab that can only find in the mangrove forest and the density of the fiddler crab can be used as a bio-indicator of mangrove forest condition, so we want to study about fiddler crab. Fiddler crab burrow serves as predator refuse and incubating egg. In this study, we tested how population density affecting fiddler crab body sizes, sex ratios, burrow shapes, burrow sizes, soil moisture, and soil organic matter. This research would help us gain a better understanding on fiddler crabs leading to better conservation. The fiddler crab conservation makes the abundance of the mangrove forest increase and to give more concern about the mangrove forest.

[Purpose of the project]

1. To study a differences of crab size between high density of fiddler crab area and low density of fiddler crab area.
2. To study a differences of burrow characteristics between high density of fiddler crab area and low density of fiddler crab area.
3. To study a different of soil quality between high density of fiddler crab area and low density of fiddler crab area.

[Methodology]

1. Study site: This study was conducted at Ban Modtanoi mangrove area, Kantang district, Trang Province, Southern Thailand (7°18′34′′N, 99°24′53′′E).
2. Time and specify the sampling point: We conducted our study during December 2020 to February 2021, during low tide.
3. Data Collection: We collected five 0.25 m^2 (0.5×0.5 m^2) quadrats in both low and high density areas with a total of ten quadrats.
4. Population density, sex-ratio, fiddler crab body size in low and high density areas.
    4.1 We collected, counted and sexed all fiddler crabs in each quadrat.
    4.2 We measure fiddler crab carapace width, carapace length, male major claw length using a digital vernier caliper.
5. Burrow shape and size in low and high density areas.
    5.1 We poured melted wax in the burrow of fiddler crab and let it sit for fifteen minutes before excavating the burrow cast.
    5.2 We classified burrow shapes into I or J-shaped burrows and measured total burrow length (TBL) and burrow diameter (BD).
6. Soil characteristics in low and high density areas.
    6.1 We identified soil texture using the GLOBE Pedosphere protocol. We collected 100-150 g of soil samples in each quadrat by using a shovel at 2 cm soil top surface and brought this soil sample back to the laboratory. We weighed 100 g of soil sample, oven dried at 120 ºC for 24 hours,

reweighed them again to calculate the percentage of soil moisture.

6.2 We weighed 20 g of oven dried soil, added 40 ml of distilled water, let it sit for 5 minutes and measured soil pH using a pH meter from supernatant.

[Results of the study]

Results showed that population density was 92.80 ± 8.67 individuals/m^2 with a sex ratio of male per female as 2:1. The density of the fiddler crab in low density is 17.60 ± 4.56 individuals/m^2 and the sex ratio is 7:4. Crab body size in the high density is larger than in low density. In both area we find the crab burrow in 2 shape as I and J. The ratio between I per J in high density is 12 :39 (male 6 :22, female 6 :17) and in low density is 8:14 (male 5 :10, female 3 :4) The study of burrow length and diameter found that the length of burrow in high density is longer than in the low density except the length of the female, J burrow as in low density is longer than high density. The soil texture in high density is sand loam and in low density is loamy sand. The organic matter in high density is higher than in low density. The sediment moisture and pH in high density is lower than in low density.

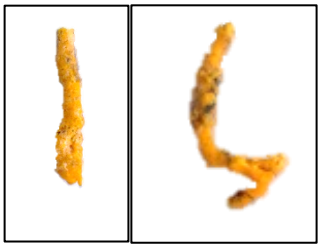
[Conclusion]

From the studied we found that in the high-density areas, the number of fiddler crab is about 5 times compare with the low density and the sex ratio of male per female was similar in both area for about 2:1. The size of fiddler crabs in high density were bigger than in the low density correlated with the %Organic matter and in both density we found 2 different types of shape as I and J shape. The burrow shape ratio in high density is higher than in the low density as in high density for about 0.2. The J shape burrow is longer and larger than the I shape as from our study we found that J shape is a permanent habitat for the crab to reproductive and incubate egg and I shape burrow is a temporary habitat using for escape the enemy. The burrow diameter in the low density is higher than the high density because of the soil texture. In the low density the female J burrow is longer than in high density as in high density the crab reproductive inside the male J shape burrow but in the low density area the crab reproductive outside the burrow and the female crab incubate egg inside the female J shape burrow.

[Future study plan]

Study more about other factors that might effect to population density of fiddler crab and changing some equipment that suit our methodology.

[Keywords]
Mangrove forest, Fiddler crab



BI-04

Mycelium and stubble substrate brick construction and analysis under varying conditions with regression models and machine learning

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[Background]

Being among the largest industrial contributors to global warming and air pollution, the Brick Industry has devastating environmental impacts. The materials used in brick kilns are not sustainable, and their continuous usage leads to unprecedented depletion of natural resources. Another major contributor to air pollution is Stubble burning, particularly in rural India. After the harvesting of crops, the stubble is burnt by the farmers due to lack of viable alternate uses of the substance, thus contributing to widespread addition of greenhouse gases.

Hence, the use of organic substrates in the construction industry is the need of the hour to ensure sustainable and economical solutions towards the goal of combating environmental damage and practising the concept of 5Rs.

[Purpose of the project]

The main objective of our research is to create a reliable, sustainable, and economical building material alternative that can compete with the conventional materials and be potential used for the construction of bricks and roads. For our research, we tested mycelium and stubble substrate mixture bricks that can not only serve as potential alternatives of clay bricks, but also provide a fruitful utilisation of the stubble.

We hypothesise that after testing various fungi and construction-temperature conditions, we would be able to create a suitable brick that would serve the brick industry the most. While several researches have been carried out on creating mycelium building materials [1][2] and using them as bricks in the construction industry [3][4], ours is the first to test the role of temperature and humidity in compressive strengths of the bricks, and use Machine Learning to predict the properties of bricks under different conditions.

[Methodology]

Firstly, samples of *Phellinus robin*, Oyster Mushroom, and Ganoderma fungi were obtained, and the tissues were placed in Sabouraud agar, a selective medium formulated to allow the growth of fungi and inhibit the growth of bacteria. Next, a mixture of stubble and sugar was created in a rectangular mould and the growing mycelium was placed inside it. Once the mycelium had intertwined with the stubble and formed a brick, it was heated in an oven at different temperatures and humidity levels. The tensile strength of the bricks so formed was measured with Universal Testing Machine for each temperature and humidity.

Next, Machine Learning, regression analysis, and statistical inference tests were performed. Once the data was collected after experimentation, in the form of temperature and humidity as explanatory-variables and tensile strength as the response-variable, a CSV file was prepared to feed into the ML notebook. Using Python programming language and Tensorflow framework, Dense neural network was created in Keras, and several optimisers and loss functions were tested. The model was used to predict the strength given the aforementioned atmospheric conditions. Tensile strength vs temperature and tensile strength vs humidity regression graphs were plotted, and the statistics, such as correlation coefficient and coefficient of determination, were calculated. Lastly, a statistical t-test was performed to generalise the results for the population and find the population mean tensile strength.

[Results of the study]

Mycelium bricks were successfully prepared under different temperatures and humidity levels. Machine learning code has also been written. Results from testing are awaited.

[Future study plan]

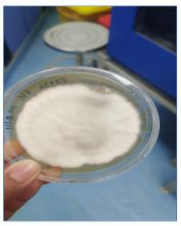
The experiment would be repeated several times in order to generate a larger dataset to improve the accuracy of the ML model. Appropriate conditions will be tested for future construction of mycelium material to be used for the construction of roads.

[Keywords]

Mycelium, Brick, Stubble, Machine Learning, Temperature, Regression analysis

BOD incubator for optimum growth of mycelial fungi at 25+/-2 degree Celsius

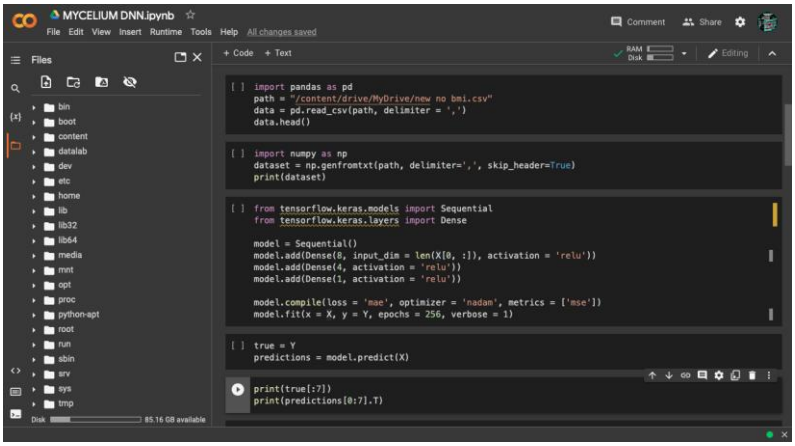
Incubator shaker for initial growth in liquid medium



Mycelial fungus growth on Sabouraud Dextrose Agar (SDA) at 25+/-2 degree Celsius

Mycelial growth with spores

ML Model for the experiment



BI-05

Innovative of plastic nanofiber from polyvinyl alcohol for plant tissue culture

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[Background]

Nowadays there are a lot of Technologies involved in the tissue culture process in order to cultivate plants. In this case for tissue culture, the medium culture that has been given to the sample has to be changed every 5-6 months which can affect the sample, thus a big budget. With this issue, we have come up with an idea to apply plastic nanofiber made from polyvinyl alcohol instead of regular synthetic tissue culture agar. Beneficial to reducing costs and for plants to last longer.

[Purpose of the project]

1. To study the concentration of polyvinyl alcohol solution affecting the structural characteristics of Plastic Nano Fibers formed by the electrospinning process.
2. To study water absorption properties of Plastic Nano Fibers.
3. To study the concentration of polyvinyl alcohol solution to make Plastic Nano Fibers suitable for plant tissue culture.

[Methodology]

Part 1 Study concentration of PVA affects the Plastic Nano Fibers structural characteristics.
Part 2 Study the water absorption properties of Plastic Nano Fibers.
Part 3 Study concentration of PVA was suitable for plant tissue culture.

[Results of the study]

Part1 - The result found that differently concentrated solutions affect viscosity. It makes a difference structure of Plastics Nanofibers from the process. The Plastic Nanofibers from 16% concentrated polyvinyl alcohol was suitable for most applications.

Part 2 - The result found that when the concentration of polyvinyl alcohol solution increases the water absorption efficiency will also be increased. The Plastic Nanofibers from 16% concentrated polyvinyl alcohol was the most effective for water absorption

Part 3 - When the concentration of polyvinyl alcohol solution used to make fibers in tissue culture increased, the diameter of the plant will also increase because polyvinyl alcohol has good water absorption properties. The concentration is higher, it absorbs the liquid well and is sufficient for plant growth. Another is the number of roots. From the experiment, it was found that there were 2 concentrations with the same number and length of roots and the largest. The highest concentration in the experiment affects the best plant growth. In addition, it was found that the plants were fungal and died. The fungal plant may be caused by contamination during the experiment. The dead plants may be caused by incomplete washing of sodium chlorite during sterilization.

[Conclusion]

In conclusion, we have found that plastic nanofiber from polyvinyl alcohol with 16% concentrated w/v has the highest efficiency for applying as the medium culture since the consistency of fiber is suitable, has the highest rate of water absorption, and with the highest tendency in plant growth

[Future study plan]

This project can be used as a reduction of culture medium in the tissue culture process, and also minimize the cost of using culture medium in the tissue culture.

[Keywords]

Absorption efficiency, Nanofiber, Tissue culture, Electrospinning

ภาพที่ 1

PVA 12% ต้นที่ 1 (ขึ้นรา)

ภาพที่ 2

PVA 12% ต้นที่ 2(ตาย)

ภาพที่ 3

PVA 12% ต้นที่ 3 (ขึ้นรา)

ภาพที่ 4

PVA 14% ต้นที่ 1 (ขึ้นรา)

ภาพที่ 5

PVA 14% ต้นที่ 2

ภาพที่ 6

PVA 14% ต้นที่ 3

ภาพที่ 7

PVA 16% ต้นที่ 1

ภาพที่ 8

PVA 16% ต้นที่ 2 (ขึ้นรา)

ภาพที่ 9

PVA 16% ต้นที่ 3

BI-06

Development of edible coating from *Gracilaria fisheri* and tannin of banana peel extracts for extending shelf life of 'Nam Dok Mai' mango fruit

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[Background]

'Nam Dok Mai' mango is an economically important fruit in Thailand. However, there are some postharvest problems limiting its shelf life, such as high respiration and ethylene production, as well as some postharvest diseases. According to postharvest technologies, fruit coating is becoming one of the most popular methods to preserve the postharvest quality of fruits (Baldwin et al., 1997; Amarante and Banks, 2001). As nowadays, consumers are more interested in healthy food, many researches have conducted on environmentally friendly methods for postharvest treatments. Since the red seaweed *Gracilaria fisheri* contains high content of agar and can be widely grown in the Southern of Thailand, this research aims to develop an edible coating from its agar extract. Moreover, tannin extract from banana peel was used as a natural additive of coating to find the optimum condition for maintaining postharvest quality and extending the shelf life of 'Nam Dok Mai' mango fruit.

[Purpose of the project]

To develop an edible coating from agar of *G. fisheri* and tannin extract of banana peel for maintaining postharvest quality of 'Nam Dok Mai' mango fruit.

[Methodology]

Preparation of *G. fisheri* agar and tannin extracts: Samples of dried *G. fisheri* (10, 20 and 40 g) were pretreated with NaOH and H_2SO_4 as modified method by Wang et al. (2017). The pre-treated seaweed samples were cut into pieces of 1 cm length, added 1.5 L distilled water (pH 6.2 - 6.5) and boiled for 1.5 h with intermittent stirring. The seaweed extracts were filtered and then used for *G. fisheri* agar extract (GE) coating treatments at concentrations of 10, 20 and 40 g/L. For tannin extraction, samples of dried banana peel were ground into powder, extracted with distilled water (1:30 w/v), incubated in water bath (50 °C, 3 h) and in incubator shaker (40 °C, 3 h). The supernatant of tannin extract was collected after centrifuged (Phanpanat, 2019). Then, the tannin extract was used for tannin extract (TE) coating treatments at concentrations of 30, 40 and 50 % (v/v).

Coating treatment: All coating treatments were mixed well with glycerol 1 % (w/v). Then, samples of 'Nam Dok Mai' mango fruits were dipped into each coating treatment, let the fruit dried at room temperature and packed into a clamshell (1 fruit/clamshell, 10 fruits/treatment).

Fruit quality evaluation: Changes in postharvest quality including percentage of weight loss, peel color (L, a, b and hue values), percentage of disease incidence (DI), pulp firmness and total soluble solids (TSS) were examined every 2 days during storage at 25 °C until the end of shelf life.

Statistical analysis: Data were subjected to analysis of variance (ANOVA) by using the SPSS program ($P < 0.05$). All data were expressed as Mean ± S.E. (n = 10).

[Results of the study]

Based on the screening of effective concentration by measuring peel color and weight loss, 20 g/L GE and 40 % (v/v) TE coating treatments were selected for determining their effects on 'Nam Dok Mai' mango fruit quality, comparing with the combination treatment (GE + TE).

Peel color: According to the results of peel color, GE and GE + TE coating treatments tended to reduce peel color change, which the treated fruits had lower L and a values compared to those of

other treatments up to day 8 of the storage.

Weight loss: All coated fruits tended to have lower weight loss than control fruits, which TE treated fruits showed the lowest weight loss, followed by those of GE + TE, on day 8 after storage compared to other treatments. These results could be influenced by a reduction of gas exchange of the coated fruits, which is related to inhibition of respiration rate (Ma et al., 2020).

Pulp firmness and TSS: TE treated fruits tended to have higher pulp firmness and lower TSS while GE + TE treated fruits showed the highest TSS, compared to those of other treatments, which was related to fruit quality maintaining.

Disease incidence (DI): Fruits treated with GE and GE + TE showed lower DI than those of other treatments up to day 6 of the storage.

[Conclusion]

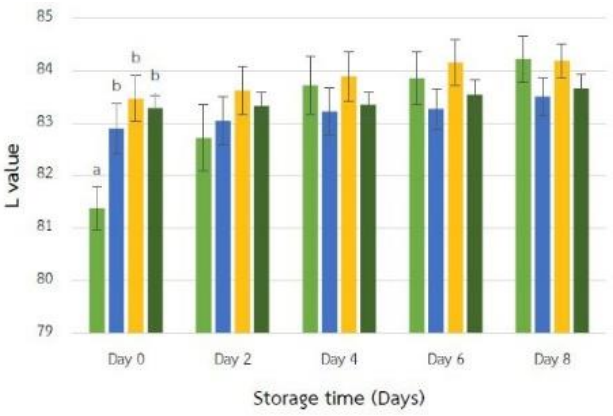
Regarding our results, the edible coating from agar extract of *G. fisheri* and tannin extract of banana peel showed some tendencies for maintaining postharvest quality of 'Nam Dok Mai' mango fruit by delaying changes of peel color, weight loss, firmness, TSS and the occurrence of disease. Therefore, These edible coatings can be an alternative postharvest treatment since they are extractable from natural and local products, which are environment-friendly and cost-effective materials.

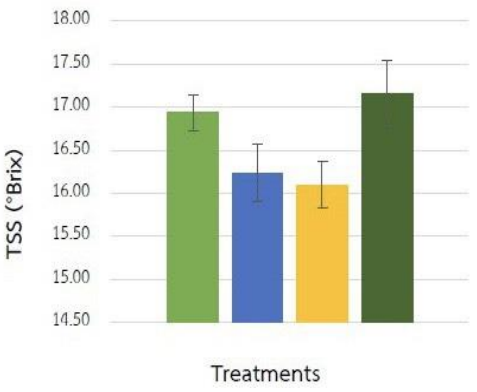
[Future study plan]

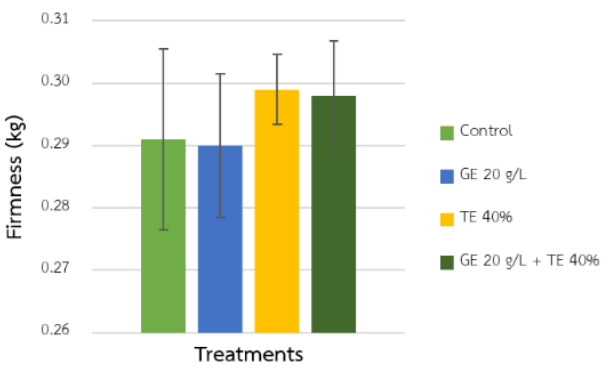
More investigation to develop a higher efficiency edible coating from *G. fisheri* agar and tannin extracts, such as determination of extracting condition and optimization of effective concentration for coating treatments.

[Keywords]

Edible coating, Tannin, *Gracilaria fisheri*, 'Nam Dok Mai' mango, Postharvest quality







BI-07

Prediction and screening of anticancer peptides against melanoma cells and to reduce melanin synthesis from the peptides of *Cannabis sativa* seed using bioinformatics techniques

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[Background]

While the prevalence of melanoma skin cancer is lower than other types of skin cancer, the mortality rate of melanoma patients is approximately three times as high as that of non-melanoma skin cancer patients. Although there are currently typical medications for melanoma and melasma, the treatments might have some terrible consequences for patients, including nausea and vomiting. Indeed, melanoma is one of the most dangerous types of skin cancer, making it critical for researchers to find a cure to alleviate the unpleasant side effects of conventional treatments Complying with the current trend of applying hemp in scientific and medical fields, using the natural substance that is hemp peptides might be a new candidate as an effective treatment. The researchers recognize the potential of bioinformatic techniques and the wide range of uses of computational techniques in the biomedical field and want to reduce the number of laboratory resources used, including the use of real hemp samples.

[Purpose of the project]

The researchers aimed to find an alternative method for cancer and melasma treatment by deciding to predict and select anticancer and anti-melanogenesis peptides from hemp (*Cannabis sativa* subsp. *sativa*) seed peptides using bioinformatics techniques.

[Methodology]

Firstly, the amino acid sequence of hemp seed was artificially cleaved by the trypsin enzyme into a number of peptides. Secondly, the researchers used machine-learning-based programs, including AntiCP, iACP, kNN, and RF algorithms, and ToxinPred, to independently predict the peptides that have the tendency to be anti-cancer, anti-melanogenesis, and non-toxic to normal cells. Then, the amino acid compositions of each group were analyzed in order to compare the proportion of amino acids in each property. Next, a Venn diagram was used to find a peptide with all properties mentioned, called anti-tyrosinase and cancer peptide (ATCP).

ATCPs were predicted by their secondary structures and docked (predicting protein-peptide binding structures) with tyrosinase, a key enzyme in the melanogenesis pathway. After that, the researchers interpreted and compared the binding site of ATCPs and tyrosinase with the controlled tyrosinase-inhibitory peptides and non-tyrosinase-inhibitory peptides from referenced research to ensure the validity of predicted ATCPs.

[Results of the study]

From all hemp seed peptides, the results indicated that there were eight anticancer peptides, 14 anti-melanogenesis peptides, and 65 non-toxic peptides. The findings indicated that amino acid composition—asparagine, tyrosine, and isoleucine—were the top three amino acids that were found higher in anticancer peptides compared to the peptides without these properties. Similarly, cysteine, histidine, and asparagine were the top three amino acids found in peptides with anti-melanogenesis properties. After inputting these peptides into the Venn diagram, there were two

peptides containing all properties: ATCP1 and ATCP2, with alpha helix and random coil secondary structures, respectively. Both were positively charged but had no ability to penetrate the cell. Furthermore, docking with tyrosinase for hydrogen bond length and position analysis revealed that these two peptides shared a tyrosinase binding site with reference tyrosinase-inhibitory peptides. Aside from that, controlled non-tyrosinase-inhibitory peptides had different ATCP1 and ATCP2 binding sites. The bonding between the peptides' asparagine and tyrosinase's leucine was found in both peptides and was also the strongest bond among all bonds; thus, having asparagine may increase the possibility of inhibiting tyrosinase and melasma. Moreover, asparagine could act as a signaling molecule to navigate the peptides into cancer cells. Finally, asparagine was identified as a potential component in peptides with anticancer and anti-melanogenesis properties.

[Conclusion]

The results indicated that two peptides, ATCP1 and ATCP2, with anticancer and anti-melanogenesis properties were found; their amino acid sequences were NAIYTPHWNVNAHSVMYVLR and QDLNHCR, respectively. These peptides were all positively charged. Furthermore, asparagine was claimed to form the strongest hydrogen bond with the tyrosinase enzyme's Leucine 130, resulting in the melanogenesis effect.

[Future study plan]

The researchers hope that this research could further the database for the study of melanoma and melanogenesis inhibition, leading to increased options for alternative therapeutics. Additionally, the result of the research should be further affirmed in laboratory stages to maximize the reliability as well as the accuracy of the potential result and to develop practical and competent alternative remedies for melanoma and melasma that can be provided to the general public.

[Keywords]

Anticancer, Anti-melanogenesis, Tyrosinase, peptide, *Cannabis sativa*, Bioinformatics

Figure 1. The secondary structure of anti-tyrosinase and cancer peptide (ATCP) [a] ATCP1 (amino acid sequence: NAIYTPHWNVNAHSVMYVLR) [b] ATCP2 (amino acid sequence: QDLNHCR)

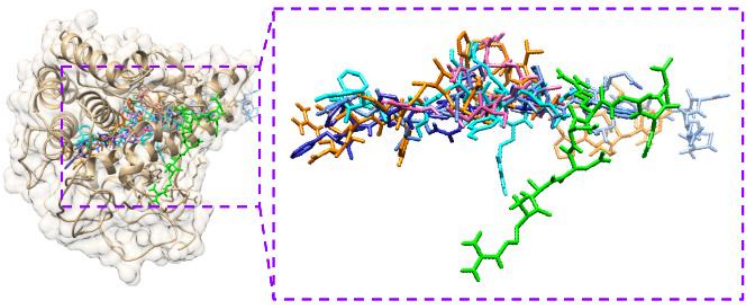

Figure 2. The binding structure of ATCP1 (orange), ATCP2 (pink), the control peptides—the tyrosinase-Inhibitory peptides (cyan, blue, and light blue), and a non-tyrosinase-inhibitory peptide (green)—with tyrosinase enzyme.

BI-08

Photosynthesis of medical cannabis plant

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[Background]

Cannabis is medical plant which presents various abundant of CBD and THC ratios. Growth and development and photosynthesis rate in auto-flowering and photo-flowering strains are necessary for inflorescences development during cultivation and before flower harvest. Organic farming of medical cannabis is a requirement for food and drug development. Artificial light and explosion time schedule require in different season for flowering control. Trimming of leaves and insect pest control present a great impact to flower quality and size of flower cluster. Characterization of each strain phenotype and secondary metabolite profile need for cannabis breeding program and bioinformatics data show high evidence of specific gene and protein material which interacts with drug target and human disease. Cannabis is a high potential crop plant for innovative food and drug discovery and development.

[Purpose of the project]

1. Growing medical cannabis for drug development
2. Study growth and photosynthesis of cannabis during cultivation period
3. Bioinformatic application for cannabis breeding program

[Methodology]

Growing cannabis plant in green house and support the female flower development with 3 hours LED light during the early morning (6.00-9.00 AM) and evening (6.00-9.00 PM(is a major process to produces high quality of inflorescences and complete growth of flowers. The hydroponics culture and the measure of growth and photosynthesis rate in commercial medical cannabis were perform in separated green house (strain no.5, 7, 12 and 19) and control indoor room with specific grow (strain no. 5, 14, 19, 20 and 21) were evaluated (photosynthetic rate (A), transpiration rate (E), difference in CO_2 concentration (Δc), difference in water vapour pressure (Δe) and Chlorophyll content). Chemical spray is not arrow in all growth stages and flowering development process. Biological control and organic substance were used to control pathogen and insect pest during cultivation time. Trimming of plant was performed before flowering period 30 and 60 days to promote flowering bud and flower cluster. Bioinformatic data of secondary metabolite in cannabis plant have applied to study and design for the further biopharmaceutical work and cannabis breeding program.

[Results of the study]

1. After seeding propagation, cannabis plant strain number 19 were grown in the green house for 110-120 days until harvest day. Control indoor plant, cannabis strain number 14, 20 and 21 were harvested in day 140 but the strain number 5 and number 19 were harvested in day 110 and 100, respectively
2. Mother plant strain number 5, 7 and 12 are growing under extra light to prolong the vegetative

stage and inhibit flowering bud, trimming of branch is necessary for develop new shoots and new branches
3. Photosynthesis rate in cannabis from green house show dramatically increase before flower harvest 40 days but the high ratio of photosynthesis rate of plant in control indoor room was found before flowers harvest time in 50 days. period development.
4.Flowering development in cannabis strain number 05 and 19 from control indoor room have been presented the late of flower development

[Conclusion]
1. Growing medical cannabis in green house need extra light period about 6 hours for flower development stage and extend the flower size and quality.
2. Growing medical cannabis in control indoor room can conduct quality of plant and control growth, pathogen and insect.
3. Auto-flowering and Photo-flowering cannabis need different propagation strategies and maintenance.
4. High photosynthesis rate shows during 5-7 weeks before flowering harvest time.
5. High number of insect pest found during flower blossom and Integrated insect pest management (IPM) program need to apply.

[Future study plan]
Drug discovery and development will focus on ratio of CBD:THC, terpene, phytosterols and flavonoid. Plant-insect interaction, drug and food product will organize under the co-operation of University of Phayao and Apinya medical CO, LTD/Thailand.

[Keywords]
Bioinformatics, Cannabis, Flower Development, Photosynthesis

This work is an early study and support by the co-operation of University of Phayao and Apinya medical CO, LTD/Thailand.

BI-09

Can the construction of Oarweed, *Laminaria digitata* and Marram grass, *Ammophila* into an organic fishing net, provide a natural sustainable alternative to the unsustainable traditional fishing nets made from plastics?

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[Background]

Ghost fishing accounts for 10% to 30% of the total debris in the ocean. This is commonly caused by bad weather, gear trapped on the seafloor, and gear conflict; equipment becoming tangled up in one another. Ghost fishing gear is the most deadly kind of plastic, killing the most marine life of all pollution. This research aims to look at natural alternative materials such as seaweed and sea grasses to replace synthesised plastic materials. Oarweed, *Laminaria digitata* was braided together with three green strands of Marram Grass *Ammophila* at varied widths, providing the base for the prototype of a fishing net material. The marram grass braids were dried for 24 hours. Two strands of similarly sized *Laminaria digitata* were plaited around the Marram base and then dried for a further two weeks. Tactile strength and flexibility were tested using a clamp and weights at a 100g per time. The strongest sample was B, with the largest width of all the materials (16mm) and the most weight held (3200g). Sample D with a width of 7-8mm held 1800g of weight. These two particular samples demonstrated that when you double the width of the braid it resulted in doubling the strength of the braid. The findings of this project provided a suggested solution for local small scaled fishing in localised and coastal waters where a smaller species of fish and quantity of fish are captured. Further research could look at the combination of natural alternatives, to withstand greater strength in order to successfully replace plastic fishing nets for other types of fishing.

[Purpose of the project]

Following this, the aim of this report and my research was to find an acceptable alternative to the current materials used in fishing net production that would be environmentally friendly and sustainable. My hypothesis to "How can local fishing net material be adapted to be environmentally friendly?" is that I would find possible alternatives to the current ones in use, but the product would not hold up a fair amount of weight, such as the weight of fish a trawling net would hold. However, for a small scale, I believed that my product would work appropriately.

[Methodology]

3 green strands of Marram Grass were braided together at various widths, and this provided the base for the prototype of fishing tool material. The braids were dried overnight. Two strands of similarly sized *Laminaria digitata* were then plaited round the Marram base. It was found that when the seaweed was wet as it was more flexible to bend for braiding, and it would strengthen the Marram base, therefore the seaweed was wet, and so the samples then dried for 2 weeks. The prototypes were measured and labelled A, B, C and D. The marram grass base on its own would act as Control of the experiment. The width of the samples varied; it provided enough range to test each sample with some inference of how similar lengths would also react.

[Results of the study]

The strongest sample proved to be B, with the largest width of all the materials (16mm) and the most weight held (3200g). Whilst the weight it was able to hold was underestimated, the ratio of its size to width made it unsurprising that it was the strongest of the materials. Furthermore, an interesting pattern, particularly between sample B and D, was observed amongst the results obtained. D had a width of 7mm and B had a width of 16mm. D held 1800g and B held 3200g. 3200/1800, rounded to the nearest unit, is 2. From this we found an interesting and unexpected link between width of Marram Strands and the weight it can hold. Double the width is double the force it is able to withstand.

[Conclusion]

The prototypes wouldn't be strong enough for use in large fishing vessels. However it could be a possibility to use for smaller scale fishing, using smaller species of fish.

[Future study plan]

Marram grass proved stronger than *Laminaria digitara*. Alternative seagrasses/ other biomatter could be tested and alternative styles of braiding could be tested.

[Keywords]

Oarweed, Marram grass, Sustainably fishing nets, Fishing nets, Plastics

BI-10

Antioxidant power of red, green and yellow bell peppers (*Capsicum annuum*)

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[Background]

Bell pepper (*Capsicum annuum*) is well known for its rich antioxidant. Considering that the colour of bell peppers has a certain extent of correlation with their ripeness, we wonder whether there would be differences in the antioxidant content and activity along with the colour varieties of bell peppers.

[Purpose of the project]

We would like to investigate the difference in antioxidant activity among red, yellow, and green bell peppers purchased from the local market in Hong Kong using DPPH assay to measure antioxidant activity.

[Methodology]

DPPH (2,2-diphenyl-1-picryl-hydrazyl-hydrate) free radical method is an antioxidant assay based on electron-transfer that produces a violet solution in ethanol. This free radical, stable at room temperature, is reduced in the presence of an antioxidant molecule, giving rise to colorless ethanol solution. Absorbance at 517nm is used to measure the antioxidant activity of a sample using a spectrometer. The formula used to calculate the antioxidant activity from absorbance is shown as follows:

$$\%\text{Antioxidant activity} = \frac{A_{(Control)} - A_{(Sample)}}{A_{(Control)}}$$

[Results of the study]

We have done two trials and both gave consistent and statistically significant results:

- Yellow bell peppers have exponentially higher antioxidant activity than the other colours
- Green bell peppers have significantly higher antioxidant activity than that of red bell peppers

The antioxidant level in descending order would be yellow > green > red

[Conclusion]

From the data analysis, it is shown that yellow bell peppers have exponentially higher antioxidant activity than the other colours, and green bell peppers has significantly higher antioxidant activity than that of red bell peppers. The result supports the alternative hypothesis (H1) that there is a significant difference in antioxidant activity among different colour varieties of bell pepper purchased in the Hong Kong market. The antioxidant level in descending order would be: yellow > green > red (bell peppers).

[Future study plan]

Most publication of similar studies suggested that red bell pepper has greater antioxidant contents and higher antioxidant activity then all other coloured bell peppers. We wonder could the differences between ours and the published studies be due to genetic factors (variations among bell pepper varieties), environmental factors like growing conditions, or individual variations such as in the degree of ripeness. In addition, would the presence of other antioxidants,

particularly vitamin C, may affect the overall antioxidant activities significantly.

We would like to explore further in the following directions:

(1) Conduct more literature review on the genetic studies of the bell pepper family and understand the mechanism in the genetic control on the colour of a matured bell pepper.
(2) Find out any correlation in the fruit colour and the antioxidant power of the bell pepper.
(3) The effect of other antioxidants, particularly vitamin C, when the carotenoid genes don't express fully such as in the light-coloured bell peppers.

Do the bell peppers found in Hong Kong markets have distinct genetic difference from those cultured in other regions?

[Keywords]
Bell pepper, *Capsicum*, Antioxidant, DPPH assay

BI-11

Development of ant-repellent gel from stevia leaf extract and enhanced with calcium hydroxide from egg shells

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[Background]

Most ant-repellent products produced from chemicals that are harmful to health. Therefore, the authors are interested in extracting stevia and making it a safe and healthy ant-repellent product.

[Purpose of the project]

Study and compare the ratio of stevia extract suitable for making ant-repellent products and develop an ant-repellent gel derived from stevia extract enriched with calcium hydroxide.

[Methodology]

Extracting stevia with 95% ethyl alcohol, when evaporated, a dark green solid was obtained. The gel was mixed with sodium CMC and guar gum. Another part was mixed with calcium hydroxide obtained from egg shells and test its.

[Results of the study]

The ant-repellent gel was obtained from the extract of ordinary stevia leaves and contained calcium hydroxide made from chicken egg shells. at concentrations of 3%, 5%, 7%, and 9%.

[Conclusion]

An ant-repellent gel made from stevia leaf extract mixed with calcium hydroxide at a concentration of 9% w/v can repel ants the best. followed by 7% w/v and 3% w/v, respectively. The mean and extermination rates were 97.67% ± 0.58%, 95.33% ± 1.53%, and 94.67% ± 1.15%, respectively.

[Future study plan]

Develop and repellent products from stevia extract to be more effective in repelling ants and studying other plants that can repel ants more efficiently.

[Keywords]

Ant-repellent product, Stevia leaf extract, Chicken eggshell

BI-12

Mode of action of antibacterial activity of Galangin plus Vancomycin against drug resistant bacteria

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[Background]

Nowadays, multidrug resistance rate of pathogenic bacteria increases continuously around the world. Vancomycin-resistant *Enterococcus faecium* (*E. faecium*) is Gram- positive bacteria that allocated as a high priority list by the World Health Organization (WHO). Synergistic effects among antibiotics or even the combination of drug and bioactive compounds still have substantial hindrances. The previous results showed 3 strains of *E. faecium* including DMST12829, DMST12870, and DMST12952 resisted to Vancomycin antibiotic at MIC > 4 µg/ml. Galangin, a bioactive compound that mostly found in the rhizome of small Galanga was effective when combined with Vancomycin, it was able to inhibit the growth of *E. faecium* DMST12829 very well (Synergism; FICI=0.31). A study expressed that the Galangin when combined with Vancomycin was significantly effective for inhibiting the growth of *E. faecium* DMST 12829. The objective of this study was to investigate the mode of action of antibacterial activity of Galangin plus Vancomycin against Vancomycin-resistant *E. faecium*, which is focus on bacterial cell membrane by cytoplasmic permeability (CM) method. This result indicated that the synergistic activity of Vancomycin and Galangin has interrupted the equilibrium of the bacterial cell membrane. In the future, synergy approach between Vancomycin and Galangin might be used as a new therapeutic substance for Gram-positive bacterial infection, slow down bacterial resistance, and reduce toxicity when using antibacterial agent alone.

[Purpose of the project]

To study the mode of action of Galangin plus Vancomycin against *E. faecium.*

[Methodology]

E. faecium was incubated in a Mueller Hinton Agar (MHA) at 37°C 18 hours. Subsequently, bacteria were separated by centrifugation. Bacteria at the bottom of the tube are dissolved in saline solution, and centrifuged two more times. Then, measure the absorbance at 0.08A - 0.13A to get the bacteria's concentration at 10^8 cfu/ml and then adjust the concentration with saline to get 10^6 cfu/ml. After that, the solution is divided into 5 conditions, which were incubated at 37°C, and collected every 0, 0.5, 1.0, 2.0, 3.0, and 4.0 hours. The solutions for each condition were collected in each hour, filtered by a 0.2 mm in vitro cellulose membrane, and centrifuged. The absorbance of the liquid was measured by UV - Vis Spectrophotometer.

[Results of the study]

Result of the cytoplasmic permeability (CM) study, it was found that combined disturbances in the equilibrium of the bacterial cell membrane from 0.5 hours at p value < 0.01 of Turkey's HSD post hoc test denoted the presence of a statistically significant difference when compared to control, Vancomycin alone, and Galangin alone.

[Conclusion]

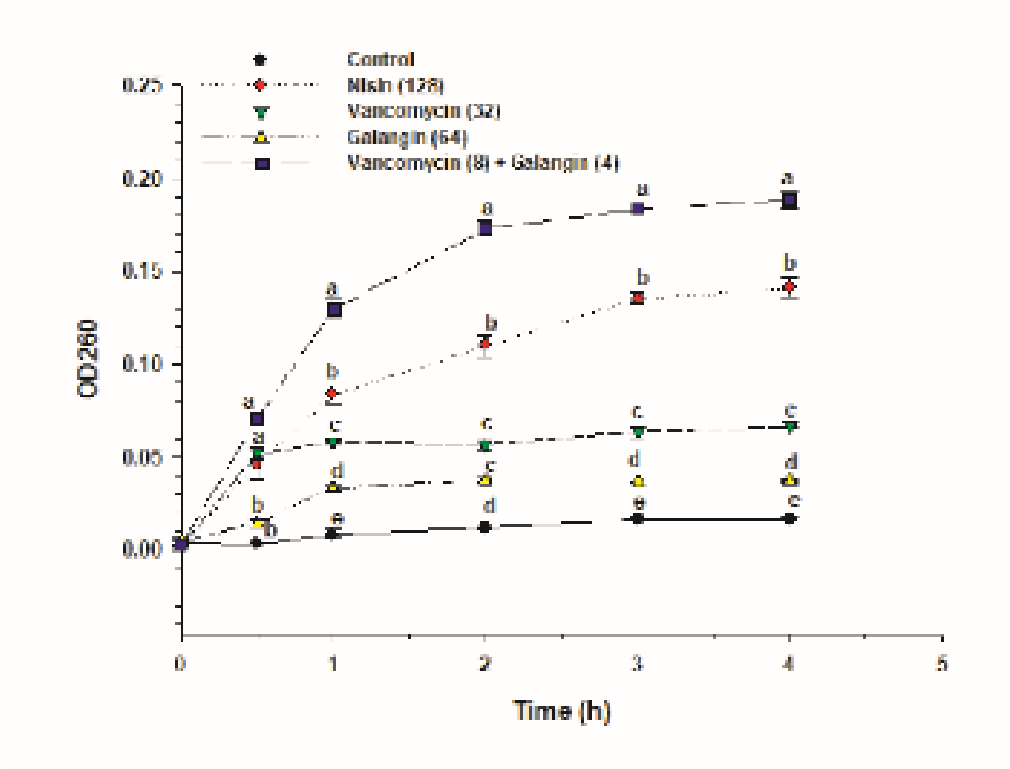
The result displayed the combination between Vancomycin and Galangin at sub-FIC significantly increased intracellular fluids leakage from the 0.5 hours to the 4 hours when compared with control, Galangin alone, Vancomycin alone, and Nisin, respectively. This result indicated that the synergistic activity of Vancomycin and Galangin has interrupted the equilibrium of the bacterial cell membrane by blocking cell membrane formation resulting the bacterial intracellular fluid leakage and dead.

[Future study plan]

Visual inspection of dead bacteria using Scanning electron microscopy (SEM) and Transmission electron microscopy (TEM).

[Keywords]

Galangin, Vancomycin, Drug-resistant bacteria, Antibacterial



BI-13

The migration pattern and possible movement of breeding grounds of the endangered oceanic whitetip shark, *Carcharhinus longimanus* in response to increasing global temperatures

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[Background]

This project is based on the effect that the increase in global temperature is having on habitats and breeding grounds of the oceanic whitetip shark, *Carcharhinus longimanus*. The migration path of the oceanic whitetip shark, *Carcharhinus longimanus* has begun shifting further north with sharks visiting cooler waters as conditions are more favourable for breeding and spawning. These unfavourable conditions have led to potentially irreversible effects such as; the species becoming endangered, local species being forced out and finally, impacting sustainable fish stocks within coastal communities. The findings of this research can be used in the future to compare past and present migratory patterns and to help predict future impacts of shifting shark populations on the migration and breeding patterns and also the sustainability of fish farming within coastal communities. Recommendations have been provided on how to sustainably manage the migratory changes of a species and the survival of coastal ecosystems.

[Purpose of the project]

To investigate the migration patterns of the oceanic whitetip shark, *Carcharhinus longimanus* and to propose a model for local, coastal fishing management.

[Methodology]

Due to the nature of our project, it was difficult to gather primary data on the desired topics. To avoid this issue, we were forced to rely on secondary data and research papers published on the necessary subject. We found this through performing online research on search engines that gave us reliable sources such as google scholar. Most of our data came from scholarly articles and research papers produced by experts in our fields. All data passed a reliability check and have been proved credible.

[Results of the study]

Oceanic whitetips (*Carcharhinus longimanus*) are a critically endangered, highly migratory species of shark which tends to live in tropical deep ocean. Whitetips can migrate hundreds of miles from their spawning areas, in order to find a reliable source of food. Overfishing has led to a critically low food source for the whitetips, and they are being forced further away due to human activity.

A study in the Bahamas placed satellite tags on 11 mature sharks to monitor movements around Cat Island, near the centre of the Bahamas. The tags monitored both horizontal and vertical movement. The study found that the tagged sharks stayed within 500km of the island for 30 days before migrating across 16,422 km^2 of the North-western Atlantic. The maximum individual displacement of the sharks reached 1940km from the island after 245 days. Many sharks returned to the Bahamas after 150 days at sea.

The study also found that there was a positive correlation between sea surface temperature and depth. Given that whitetips tend to stay shallower than 150m depth, the increasing global temperatures due to the enhanced greenhouse effect could cause the sharks to change their behaviour and start to live longer in deeper ocean environments.

[Conclusion]

Increasing global temperatures, combined with the loss of food through overfishing, can cause a further displacement of sharks from their spawning grounds. Forcing a change to migration patterns like this could potentially place the sharks into a further state of endangerment.

[Keywords]
Oceanic whitetip shark, Migration, Fishing, Population, Fishery management

BI-14

Olfactory influences on behavior in *Drosophila*

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[Background]

It was decided to use *Drosophila* because they are a model organism. Model organisms are organisms used to study universal life phenomenon. One reason is that their life cycle is faster than that of other organisms. The second reason is that the genome of *Drosophila* is open. In addition to this, there are many mutant *Drosophila* for research.

[Purpose of the project]

The purpose of this study is to better understand how *Drosophila* behavior changes with changes in the environment, such as color, sound, and smell, and to determine their ability to learn. A preliminary experiment to achieve this objective was conducted using a specifically designed V-shaped track. Changes in behavior within the track for different fasting times were observed.

[Methodology]

Before the experiment, the *Drosophila* were placed in a fasting state. Next, the Drosophila were placed in the center of the track apparatus with the food at the end of the track. The Drosophila's movement was observed by filming them for 10 minutes.

[Results of the study]

1.The groups of *Drosophila* (WT, Oregon-R) that fasted at 7:08 a.m. or 9:37 a.m. on the day of the experiment had the fewest number of *Drosophila* that stayed. The highest number of *Drosophila* that stayed put was in the 15:41 group, the closest time to the start of the experiment.
2. [*Food without propionic acid & yeast*]: A lot of individuals stayed. There was not much difference between normal and without propionic acid & yeast, but in the results of the experiment many individuals went toward normal. [*Food without yeast*]: Looking at the number of individuals going to normal food and those going to food without yeast, the number was higher in normal, but overall, there was not a big difference. [*Food without propionic acid*]: There was no significant difference between individuals going to normal and those going to food without propionic acid.

[Conclusion]

1.The transfer to the agar medium at 7:08 and 9:37 a.m. produced a longer fasting period before the experiment, so it suggests that *Drosophila* became hungry, and many individuals moved to the agar medium in search of food in the test tube. This is thought to have caused many individuals to move in search of food in V-shaped track. Conversely, individuals that had a shorter fasting period before the experiment did not become hungry and did not move to food.
2. The fact that most of them went to normal food in the situation without propionic acid and yeast, and that there was not much difference between the without propionic acid and without yeast experiments and normal food, indicates that these are the two substances that *Drosophila* recognize. Not much variance was observed in this experiment. Further experiments should be increased to verify the results.

[Future study plan]

First, Changes in the behavior of *Drosophila* should be observed by changing the wall color of the V-shaped track. Once data is acquired on which color *Drosophila* prefer, *Drosophila* will have

training to go to the color they do not prefer by using food with and without odor. Then, the trained individuals of *Drosophila* can be separated into those with good memory and those with poor memory and crossbred. The effects of individual differences on the next generation can then be researched. Second, an experiment in which the *Drosophila*'s characteristic to climb up while exposed to various Hz in a test tube will be conducted and the *Drosophila*'s movements at that time will be compared with their normal movements. Then, the *Drosophila* will have training to move in a specific direction using Hz. The genetic differences among individuals will then be researched. Third, in previous experiments, a device with V-shaped track, which has a 90-degree bend in its path, was used. However, a device that widens to 180 degrees, an I-shaped track, was also created but not used. The movement of *Drosophila* in the V-shaped and I-shaped track should be compared.

[Keywords]
Drosophila, Fasting, Yeast, Propionic acid

BI-15

Curcumin-loaded nanocomplexes alleviates acute kidney injury in hamsters-induced by adenine

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[Background]

Acute kidney injury (AKI) is a sudden loss of excretory kidney function and usually principally leads to chronic kidney disease, which is the most common in northeastern of Thailand. The predisposing factors of AKI are inflammation in blood vessels within kidney and chemical exposures inducing abnormal blood supply. Overdose of adenine can induce renal failure which affects nephron function, is used as an animal model study. Curcumin possesses an ability to anti-inflammatory, anti-fibrosis and ameliorates kidney damage. However, it has poor water solubility in water and poor bioavailability via consumption. In order to increase its efficacy, curcumin-loaded nanocomplexes (CNCs) was manipulated and developed.

[Purpose of the project]

To investigate the effect of CNCs on adenine-induced AKI in hamsters.

[Methodology]

Male hamsters were divided into six groups as follows: (1) normal hamsters (normal control, NC), (2) Adenine (Ade) treated hamsters, and combination of Ade treated and supplemented with either (3) blank nanocomplexes (Ade+BNCs), (4) CNCs 25mg/kg body weight (Ade+CNCs 25mg), (5) CNCs 50 mg/kg bodyweight (Ade+CNCs 50mg) and (6) CNC 100 mg/kg body weight (Ade+CNCs 100mg). The hamsters were daily treated with adenine for 14 days and supplemented with either BNCs or CNCs thrice a week for 28 days. Weighting of food intake, water intake, and body weight was monitored weekly.

[Results of the study]

Food and water intakes were similar weight between Ade+CNCs and NC groups. Increasing of relative body weight change was found in Ade+CNCs and NC groups. Relative kidney weight increased in Ade and Ade+BNCs group but decreased in Ade+CNCs group. Biochemical data revealed that decrease of blood urea nitrogen, serum creatinine, uric acid, and urine microalbumin to creatinine ratio were seen in Ade+CNCs 50 mg and Ade+CNCs 100 mg groups compared to Ade group. Gross appearance of the kidney in Ade+CNCs 50 mg and Ade+CNCs 100 mg groups seem to recover as brown color with little white spots compared to the other Ade-induced groups. In accordance with the histopathology changes of kidney were tubular inflammation and fibrosis lesion in Ade group, but these changes were decreased in Ade+CNCs 50 mg and Ade+CNCs 100 mg groups. Immunohistochimcal study in the kidney tissues revealed that expression of HMGB1, an early inflammatory marker, was found in the nucleus of renal cells of various cell populations, including fibroblast-like cells, pericytes and immune cells at the renal cortex in Ade group, but its expression was reduced by CNCs 50 mg and 100 mg treatments.

[Conclusion]

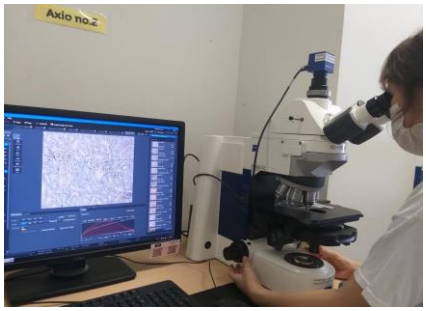
The result suggests that dose of CNCs 100 mg/kg body weight decreased serum and urine renal function test, exhibited less histological abnormality and decreased HMGB1 expression, which may have a potential to alleviate AKI by inhibiting inflammation process in hamsters.

[Future study plan]

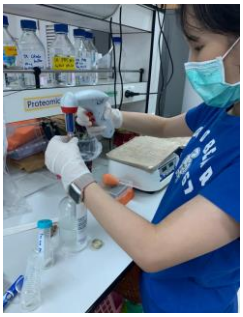
For a short-term period, the effect of CNCs on other organs and its adverse events will be investigated. For a long-term period, the application in the translational study in this study will be further evaluated in the healthy volunteer and in CKD patient. Also, CNCs will be applied for a new drug and tested in the large population.

[Keywords]

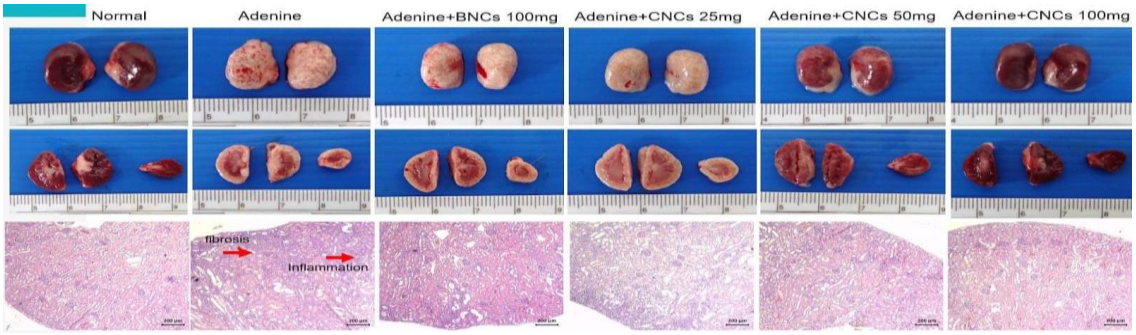
Curcumin, Nanoparticles, Acute kidney injury, Adenine, HMGB1



Investigating a sample of stained tissues



Preparing chemical substance



Representative results of the project: Gross appearance kidney and H&E staining test

BI-16

The study of red and yellow shades from local plants

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[Background]

At present, most color-related products come from synthetic colors. Synthetic dyes usually contain heavy metals, which have various negative impacts on our environment. So, we were interested in researching the colors extracted from local plants that would be environmentally friendly. We chose shades of red and yellow because they had high potential in further development of cosmetics products. We used local plants that were easy to find and inexpensive. We will increase the variety of color shades by extracting from different plants and regions including the North, Central, and Southern parts of Thailand.

[Purpose of the project]

1. To collect information on color shades from local plants and make a basic database
2. To compare the hue differences in terms of the CMYK codes and RGB codes.

[Methodology]

Firstly, extract the colors of each plant and repeat them 3 times. The parts of the plant were handled with specific extraction methods. Secondly, keep the extracts in a hot air oven to make color powder. Thirdly, dissolve the color powder in water for color analysis, which was divided four times. Then, collect shade data in CMYK and RGB code formats and create 3D graphs.

[Results of the study]

Experiment 1 with dragon fruit peels from Nakhon Pathom: The dragon fruit peels extract with hot water showed that they changed from red to yellowish brown. They also did not dry in powder form.

Experiment 2 with dragon fruit peels from Nakhon Pathom: In this experiment the dragon fruit peels were dried before being grinded into powder. To make its color powder, the fresh weight was 361.74 grams, while the net weight was 16.52 grams or 4.57 percent of the initial weight. When the dragon fruit powder was dissolved in water and measured for absorbance, the lowest wavelength was 697.7 nm. The lowest light absorption value represented the color reflected in the color. The wavelength converted to RGB code was (255,0,0), and the CMYK code was (0,100,100,0).

[Conclusion]

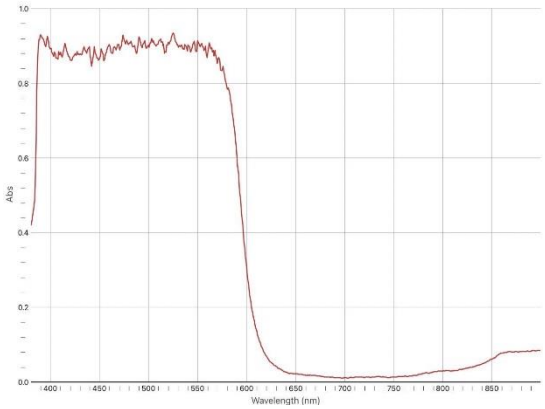
Heat destroys betacyanin substances in vacuole of the dragon fruit peel cells.

[Future study plan]

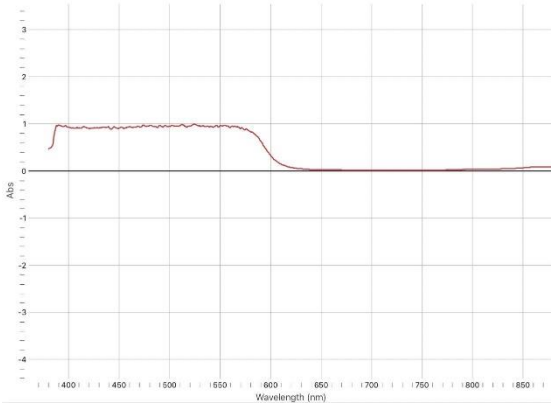
Collecting and creating shades obtained from local plant extracts and collecting data for application in dyeing clothes, cosmetics, food, or development of future products.

[Keywords]
Pigment, Natural Color, Color Codes, CMYK, and RGB

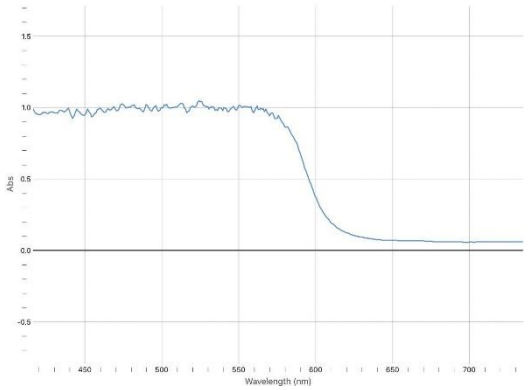
Dragon fruit powder



1st wavelength measurement



2nd wavelength measurement



3rd wavelength measurement

BI-17

Epigenetics in the future

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[Background]

We (Afke and Doae) did research about (epi)genetics. In short, epigenetics is the influence of various environmental factors on your genes, such as the temperature (climate), the food you eat and your physical and mental conditions.

In the past, for example, there was a hunger winter in the Netherlands. (1944). Many people had little or nothing to eat. The striking thing was that women who were pregnant during the winter of hunger had children who have an increased risk of diabetes. This is because mutations took place in the body of the people during the hunger winter, so that the body slowly started to adapt to less food. The goal of our project is to come up with solutions for the consequences of (epi)genetical methods and processes.

We also did our own research. In our own research, we asked about 200 people between the ages of 12 and 50 to answer a questionnaire about their diet and lifestyle. Based on those answers, we discovered a remarkable connection between some factors, for example the physical status and the BMI (body mass index).

Currently we are expanding our survey to include a real survey. We may intend to investigate the life cycle of fruit flies and relate it to (epi)enetics. In addition, we also want to see whether we can partly join an (epi)genetic research in the Erasmus hospital in Rotterdam.

Apart from our research, we also answered some questions about (epi)genetics and the connection between (epi)genetics and the Blue Zones.

We found out that it's possible to have a natural cure in the near future, but that's not without consequences. But we will tell you more about that in our presentation.

[Purpose of the project]

The purpose of our project is to extend the life span in the future and prevent diseases by applying epigenetic factors.

[Methodology]

Research by means of surveys, literature research and laboratory research.

[Results of the study]

We are still working on our laboratory research. We are currently investigating the influence of brown fat on cardiovascular diseases and how we can prevent or prevent heart disease by means of brown fat. Our survey research has shown that people who exercise less do not necessarily have a lower BMI. This is especially true in adults, but certainly not in people under the age of 18.

[Conclusion]

Future study plan: Brown fat can prevent heart disease, among other things. by means of epigenetic factors such as day and night, the embryonic period and the temperature, the amount of brown fat can be adjusted. If we have more brown fat, there is less cholesterol in the blood which prevents heart disease. In our research, we make comparisons with the blue zones.

[Future study plan]

Apply brown fat in the human body to people who have little or no brown fat to lower the cholesterol level in the blood. It has not yet been investigated whether brown fat is the cause that people are and remain thin, or whether brown fat is the result of people who are thin... We would like to investigate this further.

[Keywords]
Biology, Epigenetics

BI-18

Antifungal and antibiofilm activity of denture soft liner incorporated with ethanol extract of *Melastoma malabathricum* leaf

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[Background]

Soft denture liners are extensively used in dentistry for patients who are not able to tolerate denture-induced stresses. However, these liner surfaces provide a favorable environment for adhesion and colonization of several microbes, especially pathogens like *Candida albicans,* thereby causing denture stomatitis. A *Melastoma malabathricum* leaf is a traditional herbal medicine with pharmacological such as antibacterial and antifungal. This study aimed to investigate the antifungal and antibiofilm activities of ethanolic extract of *M. malabathricum* leaves and investigate the mechanical properties of ethanolic extract of *M. malabathricum* leaves incorporated with a soft liner.

[Purpose of the project]

1. To study the antifungal and antibiofilm effects of ethanol extract of *M. malabathricum* leaf
2. To study the mechanical properties of denture soft liner material after incorporated with ethanol extract of *M. malabathricum* leaf

[Methodology]

M. malabathricum leaves were extracted with 99.99% ethanol using ultrasonic extraction. Susceptibility testing of *Candida albicans* by disc diffusion method. Determination of Minimum Inhibitory Concentration (MIC), Minimum Fungicidal Concentration (MFC), and antibiofilm activity using Resazurin-based 96-well plate microdilution method. Test mechanical properties of denture soft liner material incorporated with *M. malabathricum* leaf extract by using a Universal testing machine.

[Results of the study]

Planktonic *C. albicans* were susceptible to *M. malabathricum* leaves extract with an MIC_{50} and MFC of 62.5 mg/mL and 125 mg/mL, respectively. The percentage of biofilm reduction was 9.40 ± 6.9 to 56.40 ± 9.70 dose-dependent manners. Therefore, Soft liner incorporated with ethanol extract of *M. malabathricum* leaf showed high elongation at break. The materials showed no significant changes in tensile strength compared with the controls. *M. malabathricum* may be useful as promising agent management for antifungal properties of denture soft lining materials.

[Conclusion]

The ethanolic extract of *M. malabathricum* leaf exhibited antifungal and antibiofilm activities against *C. albicans*. Soft liner incorporated with extract exhibited mechanical properties like reference material suggesting the possibility of this *M. malabathricum* leaf for antifungal management on denture soft lining materials.

[Future study plan]

In the future will test the antifungal and antibiofilm activity of denture soft liner after incorporated with ethanol extract of *Melastoma malabathricum* leaf and developed to be a

product that can be used to treat the elderly and extensively used in dentistry for patients safely

[Keywords]
Melastoma malabathricum leaf, *Candida albicans*, Denture soft liner material

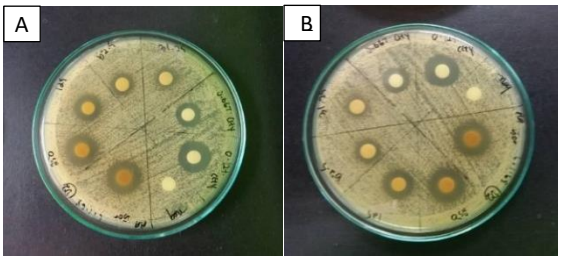

Figure 1: Inhibition zone of leaf extract at (A) 24 h, (B) 48 h.

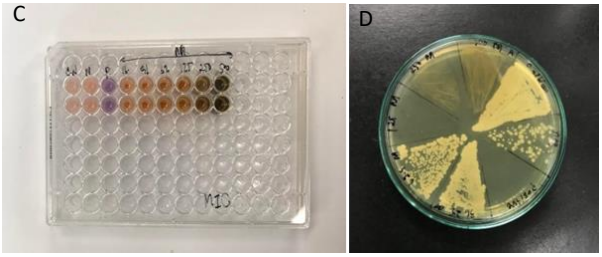

Figure 2: MIC (C) and MFC (D)

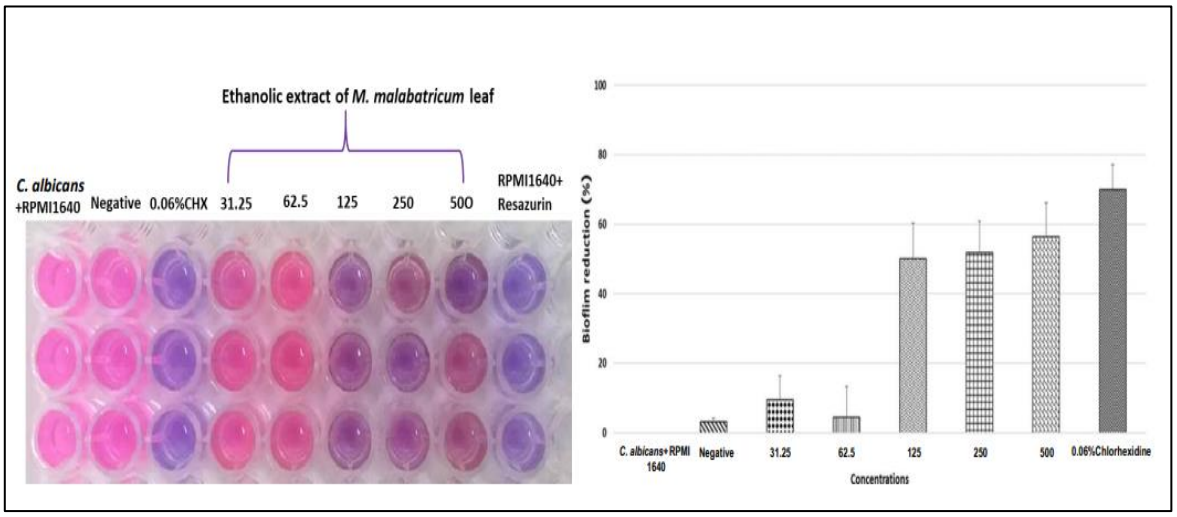

Figure 3: Percent reduction of biofilm of *C. albicans* after incubated with leaf extract at various concentrations (31.25-500 mg/ml) for 24 h (n=2)

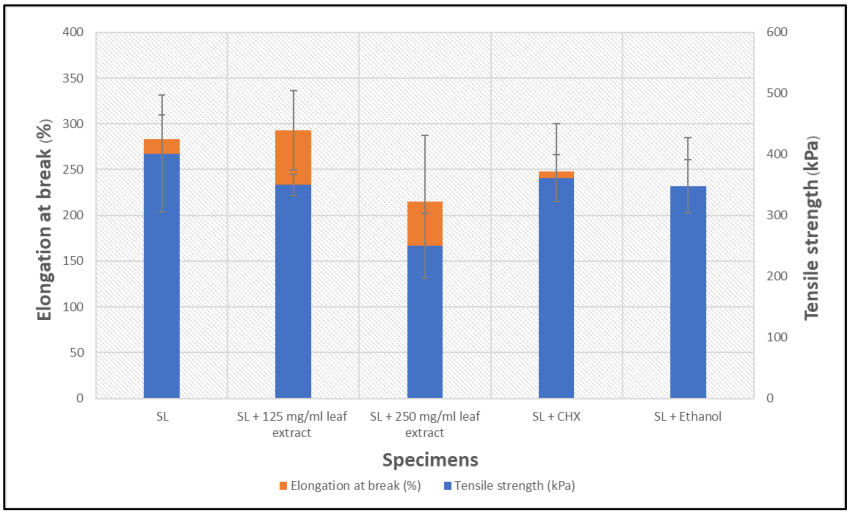

Figure 4: Compare tensile strength and Elongation at break of all specimens

BI-19

Screening of Thai red holy basil cultivars for a nutraceutical by bioactives and Eugenol synthase gene expression analysis

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[Background]

Leaves of Thai red holy basils have various purple-green colored characters that potential human health benefits regarding their accumulation of many biomolecules. Two of those are eugenol and anthocyanin which possess nutraceutical properties. These two important biomolecules found within red holy basil leaves are noted for pharmaceutical properties.

Eugenol and anthocyanin are classified as polyphenols and synthesized from the same precursor which is phenylalanine. Therefore, we investigated the relationship of eugenol with anthocyanins by determining the eugenol and anthocyanin contents in leaves of various Thai red holy basil cultivars.

[Purpose of the project]

To elucidate eugenol and anthocyanin contents from red holy basil cultivars
To find relationship between eugenol and anthocyanin content in red holy basil
To evaluate expression level of the genes regulated in eugenol and anthocyanin biosynthesis

[Methodology]

1. Tissue and extract preparation

1.1 Sample preparation: Nine cultivars of red holy basil from Thai genetics source namely OS01-OS09 and three cultivars of white holy basils namely OS10-OS12 were used in the experiment.

1.2 Crude extract preparation: Dried leaves tissue (10 g) were distilled by a rotary evaporator at 60℃. The crude extracts were collected and weighed to calculate the percentage of results.

1.3 Quantitative analysis of eugenol and methyl eugenol: Dried leaves tissue (0.1 g) were tested by using Headspace solid-phase microextraction gas chromatography mass spectrometry.

1.4 Extraction and quantitative analysis of total anthocyanins: Crude extracts were tested by pH differential spectrophotometry method.

2. Validation of gene expression involved in eugenol and anthocyanin biosynthesis: The mRNA was extracted from leaves plant tissue using RNeasy® Plant Mini Kit (Trizol) and synthesize cDNA. Then, to select the objective gene and design primers for checking gene expression by Real-time quantitative PCR (CFX managerTM).

3. Screening of the potential Thai red holy basil accessions: Consulting data of anthocyanin and eugenol contents by ranking top five cultivars of red holy basil. The results were submitted to multivariate principal component analysis (PCA) to find the relationship between anthocyanin and eugenol.

4. Statistical Analysis The variance was analyzed according to the complete randomized design trial and the mean was compared by Duncan's multiple range test at 95% confidence level

[Results of the study]

Cultivar had a significant effect on measured eugenol contents. The highest eugenol content was detected in OS05. The red holy basil accumulated total anthocyanins higher than the white holy basil. It was found that OS03 of red holy basil had high total anthocyanins, 22.76 mg cyanidin L^{-1}. To confirm the eugenol content, we carried out real-time RT-PCR for five genes encoding OsEGS1 for eugenol and OsCHS, OsCHI, OsANS and OsDFR for anthocyanin biosynthesis. Our finding revealed OsEGS1 and OsANS gene expression positively correlated with eugenol and anthocyanin contents,

respectively. The highest level of OsEGS1 gene expression was detected in OS07 that 19.10 times higher than that of the control OS10. However, there was no signal detection of Os EGS1 in the cultivars that had no estimation on GC/MS.

[Conclusion]

The top five red holy basil cultivars potentially for phytochemical usages are OS05, OS03, OS04, OS07 and OS08. There is no significant relationship between eugenol and anthocyanin content in red holy basil.

[Future study plan]

This research can be further study in Extraction of Thai red holy basil for health products and Gene marker in eugenol and anthocyanin biosynthesis.

[Keywords]
Holy basil, Red holy basil, Gene expression, Anthocyanin, Eugenol

BI-20

The effect of aposymbiotic Aiptasia on its venom composition

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[Background]

Bleaching is a phenomenon that occurs in some species of corals and sea anemones and relates to global warming. It occurs when symbiotic zooxanthellae are expelled from its host (coral or sea anemone) therefore it loses its colors.

Aiptasia is an anemone (genus: cnidarian) living in aquatic habitats all over the world. Aiptasia is characterized by a solitary polyp shape with hunting tentacles that have the ability to sting and poison its prey. Aiptasias are found mainly in shallow water, along sheltered and reef beaches or in deep rocky areas. Aiptasia can reproduce sexually and asexually.

The symbiotic interactions between Aiptasia and zooxanthellae provide the Aiptasia oxygen, sugars and amino acids. Aposymbiosis is a condition in which the symbiotic interactions are disrupted. Due to this aposymbiosis, Aiptasia will not be provided with those critical components.

Aiptasia venom contains various protein toxins, such as neurotoxins, enzymes and poreformers which perforate the membrane. Some components of the Aiptasia venom are used in the medical and cosmetic industries.

[Purpose of the project]

Our research aim is to compare symbiotic and aposymbiotic Aiptasia venom.

[Methodology]

We used hemolysis tests to determine and compare the poreformers hemolytic activity. We produced venom by mechanical stimulation of the Aiptasia (WT vs aposymbiotic) and used it to examine the neurotoxins paralytic effect on Artemia.

We used Bradford reagent to determine the protein concentrations.

[Results of the study]

Our results show that symbiotic anemone produces significantly more proteins than the aposymbiotic one (Bradford Reagent). However, using mechanical stimuli shows only minor differences between the Artemia movements of the two anemones, indicating the amount of neurotoxin production remains the same in the two anemones.

Using hemolysis also shows no significant differences in the hemolytic effect of the two anemones venom (WT vs aposymbiotic).

[Conclusion]

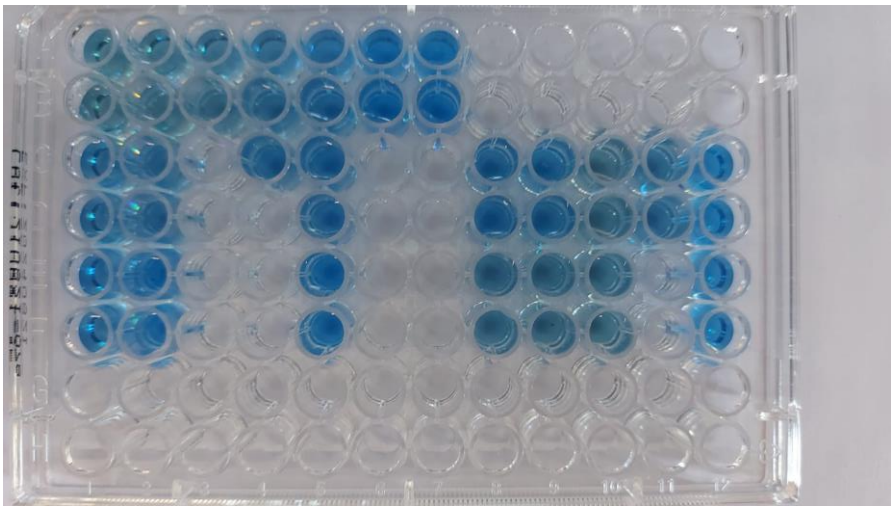
The results suggest that although the aposymbiotic anemone has less proteins than the symbiotic one, it has almost the same toxicity as the symbiotic one. Thus, the aposymbiotic anemone has a higher venom protein concentration. Our results suggest that the aposymbiotic anemone invests its resources in producing venom proteins (neurotoxins and poreformers) more than in other proteins.

[Future study plan]

Examining the composition and amount of venom produced by the aposymbiotic Aiptasia vs symbiotic Aiptasia will further expand our knowledge on anemone biology and offer new directions in biotechnology.

Producing toxins and venom from Aiptasia can be used for various purposes such as selective killing of bacteria, development of treatments against certain cancers. Further research is still needed for better understanding of Aiptasia venom protein composition, which may help determine whether growing aposymbiotic Aiptasia will be beneficial to improve proteins extraction.

[Keywords]
Aiptasia, Anemone, Symbiotic, Aposymbiotic, Poreformers, Neurotoxins,



BI-21

Screening of aerobic fibrolytic microorganisms for glucose production from waste paper

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[Background]

Due to the COVID-19 pandemic, alcohol has become a bigger part of daily life. Nowadays, there is a lot of waste paper. The paper has cellulose, the common polysaccharides contain glucose as the monosaccharide unit.

[Purpose of the project]

Tis research is just sceening of aerobic fibrolytic microorganisms for Glucose Production from Waste Paper to decrease the price of alcohol production and raise the value of paper trash and to accommodate the current increasing demands for alcohol.

[Methodology]

In this research, We picked up five samples from natural sources. There are some water in the river, pad farm, soil, dried and fresh cow dung were collected and incubated with the 100% of cellulose filter paper at 39 degree Celsius. 18 hours later. Next, enrichment of the microorganisms by moving the digested filter paper into the steriled dried and fresh cow dung solution instead of culture medium and put the 100% of cellulose filter paper and waste paper into them and incubated at 39 degree Celsius for 18 hours.

[Results of the study]

The results shown that the filter papers in the dried and fresh cow dung solution were digested. It means both of them have the aerobic fibrolytic microorganisms. And The results shown that the waste paper was digested, too.

[Conclusion]

We found the fibrolytic enzyme activity of the aerobic fibrolytic microorganisms. However, this research is just screening of aerobic fibrolytic microorganisms.

[Future study plan]

However, this research is just screening of aerobic fibrolytic microorganisms. In the future, if we use them for glucose production, we have to isolate, identification and culture them in large scale and collect only their enzyme for glucose digestion

[Keywords]

Aerobic Fibrolytic Microorganisms, Cellulose, dried and fresh cow dung, Waste paper

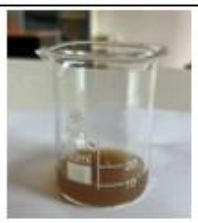
River water	Pond water	Clay	Dry cow dung	Fresh cow dung
				
				

Figure 1. Digestion of cellulose filter paper by samples from natural sources media. The top row of pictures shows the digested residue from the shredded waste paper added to the beakers of dry and fresh cow dung. The bottom row of pictures shows the pieces of filter paper after incubation, with only the paper left in the dry and fresh cow dung showing evidence of being partially digested on the left end.

	River Water	**Pond Water**	**Clay**	**Dry Cow Dung**	**Fresh Cow Dung**
Pre incubation	No colour change	No colour change	No colour change	Weak positive	Weak positive
Following incubation	No colour change	No colour change	No colour change	Strong positive	Strong positive
Following incubation with cellulose residue in boiled cow dung				Strong positive	Strong positive

Figure 2. Results of testing with Benedict's solution. Only the dung showed the presence of glucose, with the increasing level of glucose after incubation being evidence for the conversion of cellulose to glucose.

BI-22

The pollination biology of *Balanophora latisepala* (Tiegh.) Lecomte in Thailand

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[Background]

It is widely accepted in pollination systems that pollinators are necessary or indispensable in some plant species for successful pollination of dioecious plants. However, some important and valuable insights bearing this transcendental relationship between pollinators and their plants appear to be scarce, and even more so in parasitic flowering plants. According to these, the relationship between a parasitic plant and its pollinators has been both intriguing and challenging for botanists and scientists involved in the field for a long time in order to wind the secrets out of this perplexing mystery, particularly among parasitic flowering plants such as the genus Balanophora. There are six taxa of the genus distributed in Thailand, but only a few studies focusing on the pollination biology of *Balanophora* have been conducted. The pollination biology of this genus should consequently be studied to fill the gaps in knowledge. Therefore, *Balanophora latisepala*, a widespread species, was used as a model species in this study.

[Purpose of the project]

The aims of this work were to study the types of pollinators of *B*. *latisepala*, the pollination time, and the attractants or rewards for the pollinators.

[Methodology]

Field observations were taken in the foothills near Wat Phra Phutthabat Ratchawaramahaviharn, Saraburi province, Thailand. Data about floral visitors of both male and female inflorescences were collected for 43 hours, from five observations between August and October 2021. The pictures of inflorescences and floral visitors were taken. Insects were collected to identify and observe the pollen attached to their bodies. Moreover, the sugar contents of nectar and the temperature ranges of inflorescences were investigated.

[Results of the study]

According to the daytime observations, *B*. *latisepala* flowers were pollinated between 6:00 a.m. and 6:00 p.m. All pollinators were insects; the main diurnal pollinators belong to Hymenoptera, including *Apis cerana* and *Tetragonula* sp. (Apidae), *Vespa tropica* (Vespidae), and *Anoplolepis gracilipes* (Formicidae). Furthermore, two species of flies belonging to *Musca* and *Lucilia* were found visiting the inflorescence. The researchers also found that there were three taxa of nectar robbers. The male florets of *B*. *latisepala* bloom in the morning permanently and do not close up until they have dried out. The nectar-producing time indicated that *B*. *latisepala* might be favorably adapted to diurnal pollination. Most pollinator species came to the inflorescences to collect the sugary nectar secreted from the extrafloral nectary, with the exception of *Tetragonula* sp., which collected pollen without consuming nectar. The results from the investigation of temperature ranges between the environment and the inflorescence were not significantly different, leading to the affirmation that pollination was not affected by inflorescence temperature.

[Conclusion]

The daytime observation showed that *Apis cerana*, *Tetragonula* sp., *Vespa tropica*, *Anoplolepis gracilipes, Musca* sp., and *Lucilia* sp. were dominant and regular pollinators of *B*. *latisepala*. The main attractant was sugary nectar. According to the findings, *B. latisepala* may primarily adapt to diurnal pollination by providing pollinators with nectar as a reward.

[Future study plan]

To fill the knowledge gap, nighttime observations should be made. The nectar components and plant odors should be additionally investigated. Finally, the pollination biology of the remaining *Balanophora* spp. should be further studied in order to gain a complete understanding.

[Keywords]

Balanophora latisepala, Nectar, Pollination, Pollinator, Root parasitic plants

Figure 1: six taxa of pollinator

BI-23

The influences of pH on flower protoplasm

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[Background]

I have been growing morning glories every year since I was seven years old. While growing morning glories, I wondered why the color of morning glories differs between the morning and evening. Furthermore, I was interested in the fact that there are many different colors of flowers in the world. I thought that the color of flowers might be influenced by some external factors. Since I could not obtain morning glories this time, I decided to use carnations and roses, which are vacuole-type flowers like morning glories, to investigate the effect of changes in pH on flower color.

In this study, protoplasts were used to investigate the cause. Protoplasts are cells whose cell walls have been removed by enzymatic treatment. The effect of pH on them was focused on because anthocyanin, a type of flower pigment, is known to be affected by pH. Specifically, the color of extracted anthocyanin is known to be red in acidic conditions and blue in basic conditions.

[Purpose of the project]

The purpose of this experiment is to determine how the color of protoplast from flowers changes with a change in pH. In this study, carnations and roses were used to examine how the color of the protoplasts of each flower changes when they are brought to the base and acid sides.

[Methodology]

The enzyme solution for making protoplast were made using mannitol, cellulase, pectinase, KCl, and $CaCl_2$. A flower cut to a width of 1-2 mm was placed in the enzyme solution. The solution was lightly shaken using a shaking machine for 3 hours at room temperature. After enzymatic reaction, the solution was filtered with a stainless-steel mesh to remove the sliced flower and centrifuged to obtain concentrated protoplast solution (100 g, 25°C, 3 minutes). The supernatant was removed and put in the wash buffer. And then, the solution was centrifuged again the solution was concentrated. 180 µl of the solution was placed in a glass bottom dish with various concentrations of HCl or KOH. The protoplasts were observed with an inverted microscope

[Results of the study]

The results showed that the protoplasts of carnations, which were mostly light purple or pink, became dark purple or light blue when the protoplasts were brought to the base side, and red protoplasts increased when the protoplasts were brought to the acid side. Whereas rose protoplasts, which were mostly red, turned dark green or turbid orange when they were brought to the base side, but not much change was observed when they were brought to the acid side.

[Conclusion]

It was possible to confirm the color change of the flower protoplast was due to the influence of pH. When HCl was added to carnation and rose protoplasts, there were more red protoplasts in both cases. Therefore, it can be said that this is a characteristic of anthocyanin that they become red when they are acidified. Furthermore, when KOH was added to carnation protoplasts, dark purple and light blue protoplasts appeared. This is a characteristic of anthocyanin, which turns purple or blue when they are brought to the base side. On the other hand, when KOH was added to rose protoplasts, they turned green. This is not a generally known characteristic of anthocyanin. However, purple cabbage, which contains anthocyanin, is known to change from purple to green

when pH is increased. Purple cabbage is a special case, but possibly roses may have similar characteristics to purple cabbage.

[Future study plan]

Why the protoplasts went from red to green when KOH was added to rose protoplast solution needs to be investigated. In particular, how the color changes by changing the pH in the cells extracted from rose and carnation as well as the protoplasts should be observed. In addition, the changes in protoplasts that occur with changes of temperature, exposure to UV light, and the addition of metal ions should be researched.

[Keywords]
Anthocyanin, Protoplast, Rose, Carnation, pH

BI-24

Optimisation of growth of microgreens by varying seed density and growing medium

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[Background]

Microgreens are immature vegetables and herbs packed with nutrients and high levels of antioxidants. They are popular as indoor plants due to their nutritional benefits and convenience to grow at home. Despite its popularity, there is still a lack of research on the optimum growing conditions for growing these types of microgreens; Kale Curly, Beet Blood, Amaranth and Red Rambo.

[Purpose of the project]

Hence this research aims to find the most suited medium and seed density for growing these microgreens.

[Methodology]

In the first experiment, Kale Curly, Beet Blood, Amaranth and Radish Rambo microgreens were grown on soil, paper towel and cheesecloth with seed density of 0.0238g/cm^2. In the next experiment, they were grown with seed densities of 0.0119g/cm^2, 0.0238g/cm^2 and 0.0357g/cm^2 on soil. Height of microgreens were measured every 8 hours throughout 14 days of growth and rate of growth of the microgreens were analysed.

[Results of the study]

Overall, the hypothesis for the medium experiment was proven to be correct as the growth of all microgreens were the best in soil medium whereas for the seed density experiment, the hypothesis was proven wrong.

[Conclusion]

This was shown from how Kale Curly and Radish Rambo grew best in a seed density of 0.0357g/cm^2, while Amaranth and Beet Blood grew best in a seed density of 0.0238g/cm^2 and 0.0119g/cm^2 respectively.

[Future study plan]

For future experiments, a DPPH assay test can be used for testing and the relationship between the height of microgreens and its antioxidant capacities can also be researched. More different types of microgreens will be explored to further supplement our current research.

[Keywords]

Microgreens, Growth optimisation, Growth medium, Seed density

BI-25

To investigate the physiological function of kinesin Kif19A in the olfactory and taste systems of *Drosophila melanogaster*

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[Background]

The nervous system of *Drosophila* is much simpler than that of humans, but it also shows complex behavioral characteristics similar to humans, such as taste preference, learning and memory, rest and sleep. KIF19A is located at the tip of animal cilia, and the molecular mechanism of ciliary length regulation plays an important role in maintaining animal body constitution.

[Purpose of the project]

In this project, by exploring the location distribution of kinesin, adjusting the protein, and exploring its physiological function in the olfactory and taste systems of *Drosophila*. To do this, the lab set up its own ko strain of flies.

[Methodology]

1.Literature survey method
The existing literature was searched online to improve the preliminary understanding
2. experimental method
3. Comparative study method

[Results of the study]

Based on the results of the above three experiments, it can be seen from the results of the first and the third experiments that Kif19A kinesin does not play a great or significant role in the taste mechanism of *Drosophila*, and from the results of the second experiment, it also does not play a major role in the olfactory mechanism of *Drosophila*.

[Conclusion]

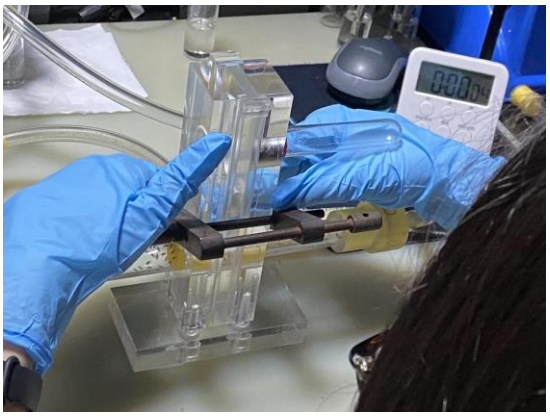
In conclusion, Kif19A kinesin has no obvious physiological function in *Drosophila* olfactory and taste systems. Although this experiment did not find the real impact flies to smell and taste way of judgment and its internal factors, but these three experiments also played a matting effect on subsequent research, provides the flies two-way choice of taste, T tube maze and nasal extending experiment data and observations, help after a lesson from the results of experiment, It continues to develop on the original basis, and finally moves forward to the key to the cause of *Drosophila* taste and smell phenomena.

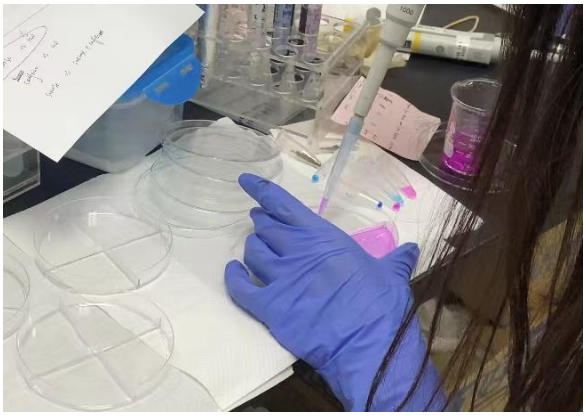
[Future study plan]

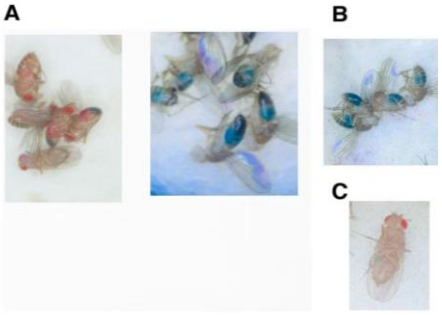
It is hoped that more repeated experiments will be carried out in the future to explore why the rescue protein did not play its original role, and to improve the experimental control group according to the specific analysis of specific problems.

[Keywords]

Drosophila, Genetic engineering, Taste test, Smell test



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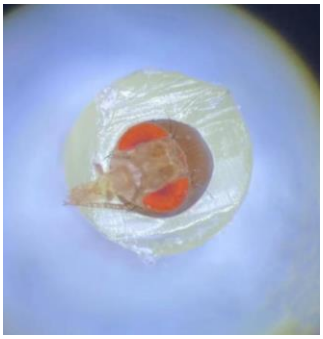

BI-26

The population of rove beetles in various biocenoses of the Smolensk region

Daria Senina

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[Background]
My project reveals a far from the most well-known topic for research in the field of entomology. Staphylinids are one of the most numerous families of animals. Unfortunately, many people don't even realize it.

[Purpose of the project]
The purpose of my work is to study the soil-litter fauna of rove beetles and to identify the dependence of the diversity of living beings on their habitat.

[Methodology]
The research was carried out in the summer of 2021, for this I chose the Smolenskoye Poozerie National Park. I managed to collect quite a few individuals and identify many species, with the help of my supervisor. After completing laboratory work and research, I calculated the Jaccard coefficient for each of the habitats selected for comparison and establishing a measure of their similarity. For a more detailed study, I used various literature.

[Results of the study]
The Jaccard coefficient was calculated for each of the habitats selected for comparison and establishing a measure of their similarity.

[Conclusion]
As a result of the research, the uniqueness of a particular biocenosis was established.

[Keywords]
Rove beetles, Staphylinids

Chemistry

CH-01

Evaluation of the effectiveness and relevance of the different methods of synthesis of carbon dots on fingerprint detection

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[Background]

Carbon dots are nanoparticles that express photoluminescence, have high biocompatibility and quantum yield and low toxicity. These traits are suitable to be applied in the field of forensic fingerprinting and address the shortcomings of current latent fingerprint detection methods. However, a set criteria on evaluating the relevance and effectiveness of the carbon dots in detecting latent fingerprints has yet to be established.

[Purpose of the project]

This review serves to set benchmarks for the comparison of traits that are applicable to carbon dot synthesis for latent fingerprint visualisation such as quantum yield, development time, ease of application, equipment required, fingerprinting level, emission colour, and synthesis time.

[Methodology]

A score calculation system was also created to be able to evaluate the papers to aid in the comparison of the papers.

[Results of the study]

Using the benchmark, fourteen articles that pertained to the use of carbon dots in fingerprinting have been evaluated and compared to find out which method produces the most optimal carbon dots for latent fingerprint visualisation.

[Conclusion]

Our analysis concluded that chemical precursors worked better than organic precursors in producing the most optimal carbon dots.

[Future study plan]

The stability of carbon dots after application on the LFP, and their ability to withstand variance in temperature and pH could be further investigated for evaluating the effectiveness of the method for synthesising carbon dots.

[Keywords]

Latent Fingerprinting, Carbon Dots, Photoluminescence, Quantum Yield, Organic Precursors, Low Toxicity

CH-02

Synthesis of carbon dots from pomelo peel for fingerprint detection

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[Background]

In Nakhon Pathom Province, there are many pomelo cultivations, generating a lot of waste from pomelo peels. This study utilized pomelo peel as a precursor to synthesize carbon dots (CDs), a non-toxic fluorescent nanomaterial.

[Purpose of the project]

- To synthesize CDs from pomelo peel
- To develop fluorescent powder from synthesized CDs solution and silica powder for fingerprint detection

[Methodology]

Synthesis of CDs was done by dispersing 0.5 g of the dried pomelo peel pallets in 10 mL of water. The mixture was heated by microwave irradiation at 90°C in a Teflon container for 10 minutes (Speedwave, Berghof, Germany). During the reaction, the pressure in the container was 10 bar. Absorption and fluorescent emission spectra of the CDs filtrate were measured by a portable spectrometer (Labquest, Vernier Scientific, USA) and fluorometer (FP-8300, Jasco, USA).

The fluorescent powder was synthesized by mixing the CDs solution and silica gel (70-230 mesh, Merck, Germany) in various ratios. Sample code CSx refers to x mL of CDs solution per 1 g of silica gel. The mixture was heated to dryness on a hotplate. The relative fluorescent intensity was evaluated by taking an image of the powder under 365 nm UV light. By using ImageJ freeware (National Institute of Health, USA), the image was converted to 8-bit grayscale with brightness value between 0-255. Patent fingerprint was made by pressing a thumb on the face's T-zone and then on the non-porous surfaces: plastic sheets, glass slides, aluminum can. Fluorescent powder was sprinkled on the patent print before imaging under white light and UV light.

[Results of the study]

1. Property of fluorescent powder

The dispersion of pomelo peel pallets in water appears as charred solid in dark brown solution after microwave digestion. The CDs filtrate has maximum absorbance at 390 nm and a maximum emission at 485 nm, which appears as blue fluorescence. The excitation and emission maximum of CDs solution in this work is different from those reported by Lu et al. (2012), whose absorbance peak at 280 nm and a maximum emission at 444 nm, in which CDs was synthesized from pomelo peel by hydrothermal methods. It is known that synthesis method and condition can affect the CDs photophysical properties.

Silica gel coated with CDs appears as pale brown powder; the higher the ratio of CDs, the darker the color. Under UV illumination, the untreated silica gel is indistinguishable from the white plastic background, while the silica gel coated with CDs appears brighter. The CDS0.5 and CS1 has higher relative fluorescent intensity than other samples. Increasing the ratio of CDs solution results in lower brightness (Figure 1). The phenomenon of solid-state fluorescent quenching happens in the mixture containing high proportion of fluorophore to matrix which can result from partial aggregation of fluorophore (Wang et al., 2020).

2. Patent fingerprint detection

Silica gel can selectively adhere to the natural oil and sweat on the patent fingerprint. The minutiae and ridges of the fingerprint on a black plastic surface were clearly visible after dusting with untreated silica gel. However, the untreated silica gel on the fingerprint was hardly visible on a white background. Under the UV light, the advantage of the fluorescent powder became more apparent as the fingerprint could be detected regardless of the background color (Figure 2). The contrast of the fingerprint on the white plastic surface was not as sharp as the black surface because most white plastic contains brightening agent which also emits blue glow.

Similar problem was encountered in detecting the patent fingerprint on an aluminum can as the fingerprint was not distinguishable from the bright reflective background (Figure 3). The fluorescent powder in this study was still unsuitable for use on reflective background or surfaces containing fluorescent materials. This problem can be overcome by improving fluorescent quantum yield of the CDs solution. For other non-reflective and non-porous surface such as plastic and glass, the developed fingerprint showed better contrast under UV illumination in comparison to the image obtained under normal light.

[Conclusion]

This study demonstrated the use of microwave digestion for synthesis of fluorescent CDs solution from pomelo peel. Silica gel powder coated with carbon dots solution appears as yellow powder with blue glow under UV light at 365 nm. The fluorescent powder can be used to visualize fingerprints on non-porous and non-reflective surfaces such as plastics and glass. The image from UV illumination is sharper than those under white light especially in the case of fingerprints on white color background. Further investigation is needed regarding the synthesis method for higher fluorescent CDs and the shelf-life of fluorescent power.

[Future study plan]

We are going to optimize the synthesis method for higher quantum yield, measure the size of CDs and study the storage condition and shelf-life of fluorescent powder.

[Keywords]

Pomelo peel, Carbon dots, Fluorescent powder, Patent fingerprint

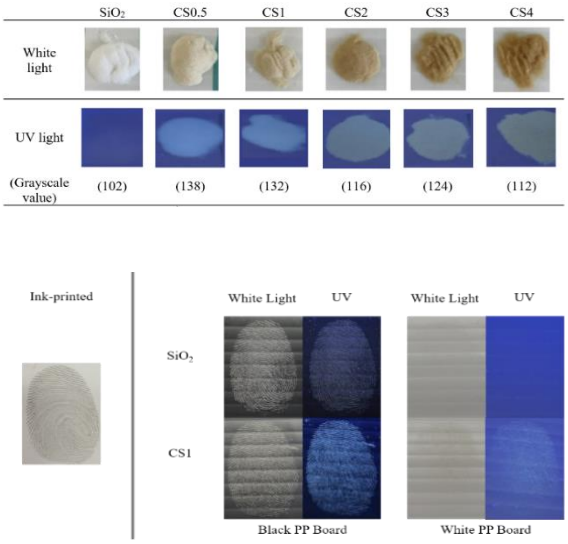

Figure 2. Imaging of patent fingerprint on polypropylene board

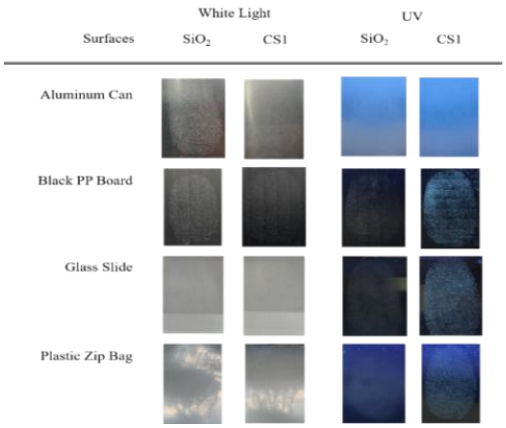

Figure 3. Imaging of patent fingerprint on non-porous surface of metal, glass, and plastic

Figure 1. Silica gel and silica gel coated with carbon dot under white light and UV light

CH-03

Magnetic nanoparticles decorated titanium dioxide nanocylinders for cancer therapeutic delivery

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[Background]

Chemotherapy is one of the most popular cancer treatments due to its high efficiency. In this treatment, chemicals or drugs are used to kill or stop cancer cells reproducing, which prevents them from growing and spreading in the body. Since, the treatment is not specific to cancer cells. It can damage some healthy cells in a body. This led to a wide range of unpleasant side effects such as severe coughing, nausea, vomiting, hair loss, and infections. Several drugs used in chemotherapy is hydrophobic, poorly soluble and quickly loses their biological activity in the bloodstream resulting in an insufficient uptake by cancer cells. This requires an increase applied drug's concentration leading to serious side effects on healthy cells and an increase in a number of drug resistance cancer cells. To solve such problems, it is necessary to create a drug delivery system that can deliver drugs to target cells quickly, without affecting normal cells.

[Purpose of the project]

The objective of this project is to synthesize titanium dioxide nanocylinders (TiO_2 NCs) for magnetically guided cancer therapeutic delivery

[Methodology]

First, 3 layers of titanium dioxide nanotubes *(*TiO_2 NTs*)* were synthesized by 3-step anodization method in an electrolyte containing Fluoride ions using voltages of 60V for 1 hr, 5V for 10 min, and 60V for 1 hr, respectively. Magnetic nanoparticles were then decorated on*/*into *(*TiO_2 NTs*)* by immersing the anodized titanium *(*Ti*)* film in a solution of magnetic nanoparticles for 30 min. Drop-casting method was used to add Camptothecin *(*CT*)*, anticancer drug, in the TiO_2 NTs. Sonication for 15 min was then conducted to separate magnetic nanoparticles decorated TiO_2 NCs filled with CP *(*CT-Fe_3O_4@TiO_2 NCs*)* from the anodized Ti film before centrifugation to remove broken TiO_2 NCs.

[Results of the study]

FE-SEM results revealed 3 layers of TiO_2 NTs after 3-step anodization and TiO_2 NCs after sonication and centrifugation. Diameter and length of the synthesized TiO_2 NCs are in the range of 70-90 nm and 1.0-1.5 µm, respectively. Images from AFM indicated that wall thickness of the TiO_2 NTs decreased after decoration of magnetic nanoparticles found accumulated mostly at the edge of TiO_2 NTs. EDX results confirmed the presence of magnetic nanoparticles on or inside TiO_2 NCs. Motion of the CT-Fe_3O_4@TiO_2 NCs was successfully controlled using external magnetic field. UV-vis results indicated that using external magnetic field to shake the CT-Fe_3O_4 @TiO_2 NCs helps release of CT, which is hydrophobic drug from Fe_3O_4@TiO_2 NCs.

[Conclusion]

In the present study, we successfully synthesized Fe_3O_4@TiO_2 NCs for delivery of hydrophobic anticancer agents. Average diameter and length of the TiO_2 NCs are approximately 80 nanometers and 1.0-1.5 micrometers, respectively. Release of CT, hydrophobic drug was easily achieved with the aid of external magnetic field. Motion of the CT-Fe_3O_4@TiO_2 NCs can be controlled using external magnetic field.

[Future study plan]

This project could be further developed for delivery of other therapeutic agents for cancer therapy. We are going to study the structure of the carriers for developing their performances and test them with other drugs. In addition, the drug carriers will be tested with cancer cell to check their ability.

[Keywords]

Nanocylinder, Magnetic nanoparticles, Drug delivery, Camptothecin, Drug carriers

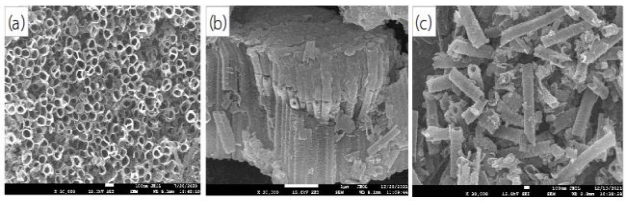

Figure 1. A top-view (a) and a cross-sectional image (b) of TiO_2 NTs after 3-step anodization, an TiO_2 NCs obtained after sonication of (a) and (b).

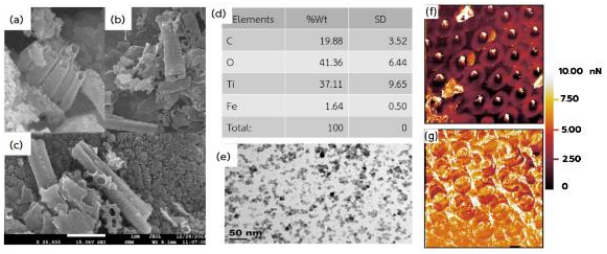

Figure 2. FE-SEM images of TiO_2 NCs after decoration with Fe_3O_4 NPs (a)-(c), atomistic composition of Fe_3O_4@TiO_2 NCs (d), and TEM image of Fe_3O_4 NPs (e) including before (f) and after (g) decorated ion of Fe_3O_4 NPs on/inside TiO_2 NTs.

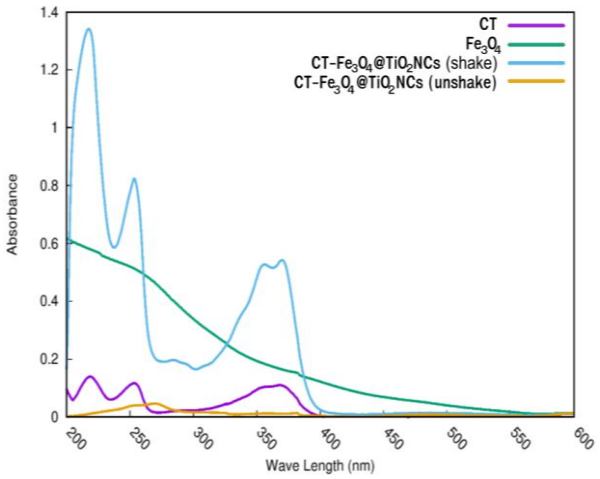

Figure 3. UV-vis spectra of camptothecin (CT), magnetic nanoparticles (Fe_3O_4), TiO_2 NCs doped with Fe_3O_4 and filled with CT without (CT-Fe_3O_4@TiO_2 NCs (unshake)) and with (CT-Fe_3O_4@TiO_2 NCs (shake)) external magnetic shaking in PBS 10 min.

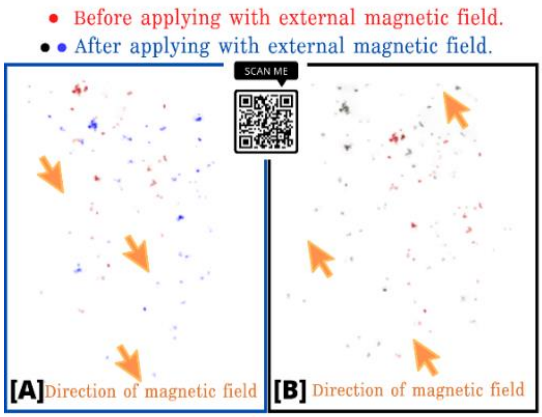

Figure 4. A photo obtained from a microscope showing locations of clusters of magnetic nanoparticles before (blue and black dots) and after (red dots) applying external magnetic field in the direction of orange arrows including QR code is a code for watching the video showing their motion.

CH-04

Preparation and applications of mud microbial fuel cells

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[Background]

The energy self-sufficiency rate in Japan is low compared to other developed countries. Mud cells are eco-friendly and have the potential to be used as a source of renewable energy. Furthermore, a vast amount of unused agricultural land exists in Japan, and therefore production of these cells can lead to more effective use of land.

[Purpose of the project]

The purpose of this study is to improve the generation efficiency of the power of mud cells.

[Methodology]

In a mud cell, electric current is generated by power-generating bacteria in the soil, oxidatively decomposing organic matter and respiring with anode electrode as an electron acceptor. The electrons reach the cathode via external resistance and are used in the oxygen reduction reaction. Since the oxygen reduction reaction at the cathode has a higher potential than the organic oxidation reaction at the anode, electrons flow from the anode to the cathode and power is obtained.
The muds were collected from four places: our school garden, Hama Rikyu Garden, Yatsu Tidal Flat, and Koiwa Iris Garden. Mud cells were prepared using the muds and carbon felt as the two electrodes. These were put in an incubator maintained at constant temperature, and the voltage between the electrodes connected to a 10 kΩ solid resistor were recorded. The maximum power of the cells was measured by using potentiostat once a week.

We conducted six experiments. In the first experiment, the performance of mud cells made of different soils were compared. In the second experiment, the difference of battery output was checked by changing in the temperature from 20 degrees Celsius to 30 degrees Celsius using mud cells with good performance in the first experiment. In the third experiment, different performances by changing salinities of the muddy water were confirmed. In the fourth experiment, the types of nutrients suitable for the culture of the electricity-producing bacteria were identified. Sodium citrate, sodium succinate, sodium tartrate, and potassium hydrogen phthalate were added to the mud cells. In the fifth experiment, bacteria floras in mud and anode were analyzed using next-generation sequencing. In the sixth experiment, the effect of connection type in series and parallel on power generation will be investigated.

[Results of the study]

The results of each experiment are as follows:
Exp. 1: The voltage of mud cells made from the schoolyard mud increased, and the schoolyard mud had the highest power generation of the four with the value of 37.1 mW/m².
Exp. 2: In the experiment2, maximum power density at 30 degrees Celsius was 1.2 times higher than at 20 degrees Celsius.
Exp. 3: The 3 % NaCl aqueous solution had the lowest maximum power value, 4.6 mW/m². The 1 % NaCl aqueous solution had the highest maximum power value, 47.1 mW/m².
Exp. 4: The voltage and maximum power value were stable and high for all nutrients.
Exp. 5: It can be seen that the electrode has more of Geobacter bacteria which known to power-generating bacteria and their close relatives. At Hamarikyu, Geobacter bacteria could not be confirmed this time. However, the mud cells at Hamarikyu are generating electricity.

[Conclusion]

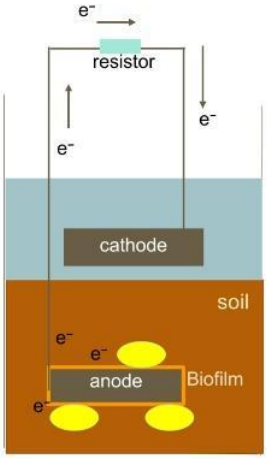
From experiments 1 and 4, soil covered with fallen leaves generates more electricity than pond mud. Four reagents that we used, derived from fallen leaves were adequate as the nutrients for the electricity-producing bacteria culture. From the experiment2, 30 degrees Celsius generates better power than 20 degrees Celsius. From the results of experiment3, salinity of 1%shows best power generation. Also, from the experiment5, we can say that Geobacter bacteria are being used for power generation. Furthermore, it is possible that power was generated by a yet unknown power-generating bacteria, which is a close relative of Geobacter bacteria.

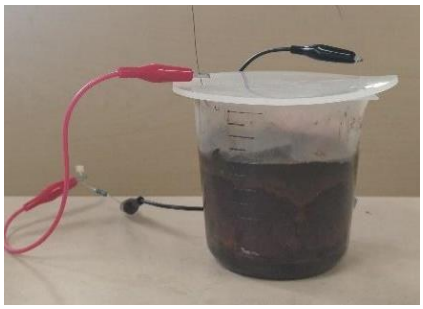
[Future study plan]

Our future plans are to identify the nutrients of the culture, to identify other reagents for the electricity-producing bacteria, to investigate distribution of the electricity-producing bacteria, and to evaluate the performance of mud cells using soil from other places.

[Keywords]

Mud cell, Power-generating bacteria, Microbial fuel cell





CH-05

Sawasdee-AMP: Highly efficient, portable and low-cost point of care test kit for future emerging RNA/DNA disease diagnosis

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[Background]

Coronavirus, an RNA virus that causes COVID-19, has spread widely around the globe. However, not only RNA-type viruses, but DNA-type also exist. An accurate and portable diagnostic technique can effectively limit the spread of such viruses. Nowadays, Polymerase Chain Reaction (PCR) and antigen test kits (ATK) are widely used. Although PCR is highly reliable, it is expensive, complicated, and laboratory-use-dependent. While the ATK is simple and cheap, its results can be unreliable. Therefore, we would like to combine the advantages of both methods to create a test kit with high reliability while still simple and cheap so it can be affordable for everyone.

[Purpose of the project]

To develop a test kit model that fulfills the need for a point-of-care test kit with a simple procedure, being able to work in field testing or screening sites, yet is highly reliable and has high sensitivity at a low price.

[Methodology]

Our novel test kit (Sawasdee-AMP) integrates loop-mediated isothermal amplification (LAMP) with the pH-sensitive dye to deliver a blue-to-green color that is visible to the naked eye within 3 steps:

1) Finding the most suitable pH-sensitive dye: first, we simulated several mixed dye pairs for the pH range of 6.0-8.5. Then, we mixed these colors using a computer program and listed out some suitable mixed dyes. After that, we combined several pairs of pH-indicator that we chose before in the laboratory. Then, we put those mixed dyes into RT-LAMP reactions and observed to find the most usable one. Finally, we optimized the condition of the RT-LAMP system and tested the efficiency of the process.

2) Genetic materials extraction: we established a 5-min equipment-free sample preparation procedure to use with our kit and compare it with the standard commercial method, TRIzol reagent, to find our method's efficiency.

3) Inventing the test kit box: we developed and test the efficiency of the portable test kit box to use in place of a complex and expensive laboratory tool, the PCR thermal cycler.

For the proof-of-concept of our test kit, versatility testing is needed. We changed pathogen-specific primers to match each of the pathogens (both DNA and RNA type viruses, bacteria, and parasites that infect humans, animals, and plants), while conducting the same methodology as the optimal condition of our test kit to find whether our test kit can truly adapt to diagnose various types of pathogens.

[Results of the study]

Sawasdee-AMP delivers a blue-to-green color result that is visible to the naked eye with 96% accuracy, and 10 times higher sensitivity than the RT-PCR, with the detection limit approaching 10 copies of the targeted genetic materials. A 5-min, equipment-free, genetic materials extraction procedure was established with high efficiency compared to the standard commercial method, and a portable, 5-dollar test box also provides approximate efficiency to a thousand-dollar PCR machine.

These have made the whole diagnosis process take less than 1 hour from sampling to visible result readout within a cost of 2 dollars, namely 4-6 times faster, and 10-fold cheaper than conventional PCR methods. Lastly, by slightly modifying the Sawasdee-AMP testing solution by changing pathogen-specific primers, various target DNA and RNA viruses, bacteria, and parasites representing human, animal, and plant infections can be diagnosed correctly for each and all of them.

[Conclusion]

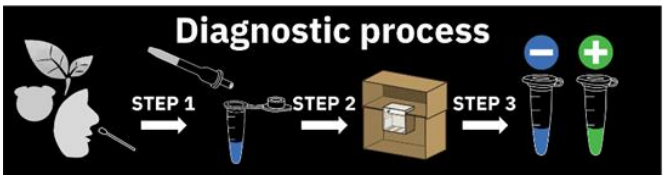
Sawasdee-AMP takes less than an hour for the entire diagnosis process to be completed, that is from sampling to readout. This is a lot faster than 4-6 hours of processing PCR tests. It is also 5-10 times cheaper and has 10 times higher sensitivity than PCR methods. The model is capable of outside laboratory equipment-free diagnoses. Therefore, field testing and screening in such places as hospitals or gathering sites are available. Since Sawasdee-AMP can be modified to diagnose various types of pathogens, it could be adapted to use for a broad range of purposes, making it full of the potential of being a model for emerging point-of-care disease diagnoses to deal with emerging diseases in the future.

[Future study plan]

Increasing the lifespan of the LAMP pre-mix, which are LAMP starting materials, and improving the test kit box to be a three-in-one testing kit that includes all the substances needed for the all steps.

[Keywords]

Reverse Transcription-Loop Mediated Isothermal Amplification (RT-LAMP); RNA and DNA viruses, bacteria, and parasites; Sensitivity, Specificity, Reliability



CH-06

The CO_2 converting incinerator

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[Background]

Research shows that humans are putting an estimated 9.5 billion metric tons of carbon into the atmosphere each year just by burning fossil fuels alone, and another 1.5 billion from deforestation. In all of that amount, trash incineration contributes about 29 percent of officially reported human-related global emissions. With so much carbon being released into the atmosphere when there is already plenty still up there, our planet's living conditions will only worsen at an alarming rate if nothing is done.

[Purpose of the project]

As the human population continues to increase, the amount of trash we produce also increases. Research shows that every year we dump about 2.12 billion tons of waste globally. For instance, people in Phnom Penh alone produce about 10 thousand tons of trash per day. As the number of garbage increases, landfills become inefficient and so the government as well as the citizen are left with no choice but to burn it. So that we can free up more space for future trash. But the process of burning down the garbage destroys Cambodia's atmosphere and the health of the people living in those areas as well. Moreover, those toxins that got released into the atmosphere are one of the biggest contributors to climate change as well as global warming in Cambodia. Thus, this is why we came up with this project idea, in hope that this project will someday become a reality to solve all of the problems we just mentioned above.

[Methodology]

- The methods we use to define our problems are, through surveys in which we created a google form for people of all ages to fill in and answer according to their own opinion and views. And through researching reliable sources in order to get more intel and data on our topic.
- For the chemical reaction part, we settled on using a chemical reaction called thermolysis which is a reaction that happens when molecules break down once they reach a certain heat.

[Results of the study]

As a result of our research, it is in fact proven that carbon could separate from oxygen in CO_2. This decomposition is done through a chemical reaction called thermal decomposition or thermolysis. This reaction is endothermic meaning it requires heat for the molecular decomposition process. But a downside for thermolysis is that the reaction is extremely energy-intensive and requires a high amount of heat (700-1500 degrees Celsius), which might release even more carbon.

[Conclusion]

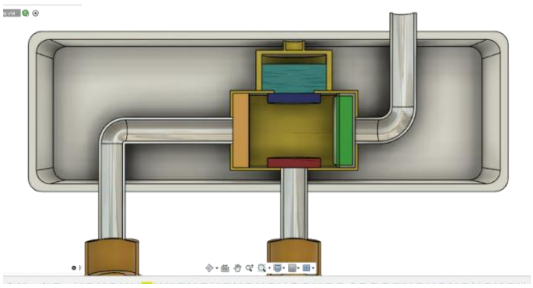
We can conclude that manufacturing this machine will be one step closer to humanity as a whole overcoming our planet's destruction. With all the benefits this machine brings to our planet, such as decreasing greenhouse gas levels, slowing down climate change, and other world-changing benefits, it is without a doubt that this would be the right step forward.

[Future study plan]

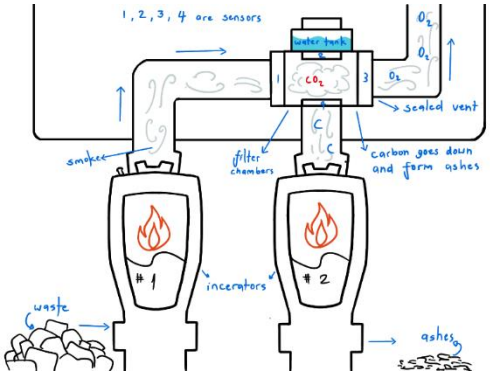
- Currently, our incinerator is only designed to capture CO_2 and break down the molecular compound of CO_2 in smoke. So, for future developments, we would like our machine to break down other greenhouse gases such as methane and nitrous oxide. We will invest more research

into this topic.
- Ash, which is a byproduct of burning trash and our machine's filtering process, is extremely harmful to soil quality. Therefore, we plan to implement a curing process into our machine to cure the ashes that are produced, into a substitute for cement.

[Keywords]
The CO_2 converting incinerator, Inefficient Landfills, Thermolysis.



The 3D design "Prototype" of the incinerator



The Process of how this incinerator works

CH-07

The development of fruit and microgreens smoothies for elders based on antioxidant capacity and sensory evaluation

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[Background]

Antioxidants are essential due to the ability to scavenge free radicals, which cause many diseases. Natural antioxidants are either synthesized in human bodies or obtained from food. However, the antioxidant production decreases with age, plus the elderly usually have trouble chewing leading to inadequate consumption of antioxidants. In this work, high antioxidant capacity and tasty smoothie recipes were developed from microgreens and fruits including kale, broccoli, green oak, water spinach, red amaranth, banana, mango, pomelo, mulberry, and guava.

[Purpose of the project]

To develop fruit and microgreens smoothie recipes with high antioxidant capacity and sensory test.

[Methodology]

Ten smoothies of microgreens and fruits, including kale, broccoli, green oak, water spinach, red amaranth, banana, mango, pomelo, mulberry, and guava, were individually assessed for sensory evaluation by nine participants over the age of 45. Five-point hedonic scale was used to evaluate the smoothies for taste, aroma, texture, after taste, appearance, and overall satisfaction. Each smoothie was also estimated for total antioxidant capacity (TAC) and total phenolic content (TPC) using 2,2-diphenyl-1-picryl-hydrazyl-hydrate (DPPH) assay and Folin-Ciocalteu assay, respectively. Two smoothie recipes were then developed based on individual TAC, TPC, and sensory score of each fruit and microgreen.

[Results of the study]

The results show that mulberry smoothie had the highest TAC and TPC followed by broccoli smoothie; meanwhile, both mango smoothie and banana smoothie received high overall satisfactory scores. Two smoothie recipes were then developed from the microgreens and fruits with highest antioxidant capacity and sensory profiles. The first recipe consisting of banana, mango, and broccoli had TAC and TPC values of 0.49 ± 0.61 mg Ascorbic Acid Equivalent (AAE)/mL and 5.04 ± 0.04 mg Gallic Acid Equivalent (GAE)/mL, respectively. The second recipe consisting of mulberry, mango, and broccoli had TAC and TPC values of 12.63 ± 1.13 mg AAE/mL and 20.41 ± 0.14 mg GAE/mL, respectively. Both smoothie recipes had high sensory perception with no statistically significant difference ($p > 0.05$).

[Conclusion]

Two smoothie recipes based on antioxidant capacity and sensory test of each fruit and microgreen were developed in this work. The second recipe (consisting of mulberry, mango, and broccoli) had higher antioxidant capacity than that of the first one (consisting of banana, mango, and broccoli). It also had high sensory perception. Therefore, the second recipe was chosen as a promising beverage to increase antioxidant capacity for the elderly.

[Future study plan]

The following topics could be studied:

1. Other essential nutrients in smoothies
2. Develop other smoothie recipes
3. Smoothie preservation and shelf-life

[Keywords]

Antioxidants, Microgreens, Total Phenolic Content, Total Antioxidant Capacity, Sensory Test

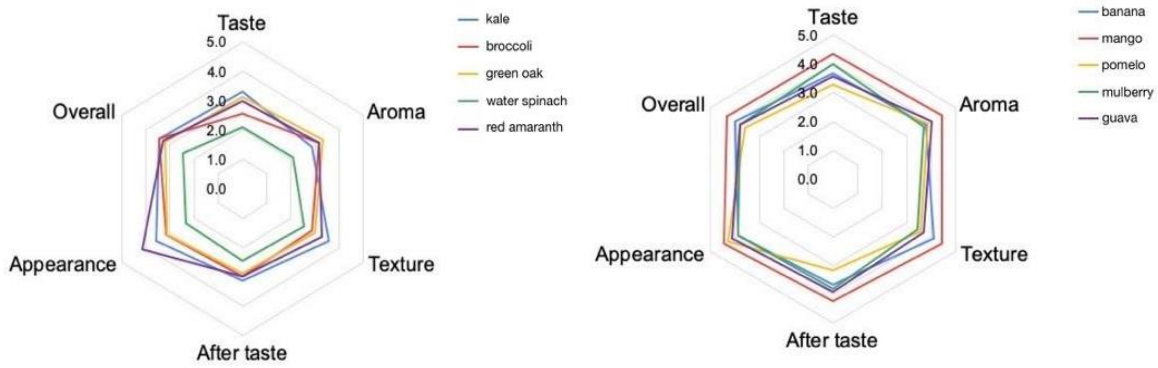

Figure 1. The results of sensory evaluation of (a) 5 types of fruit smoothies and (b) 5 types of microgreens smoothies.

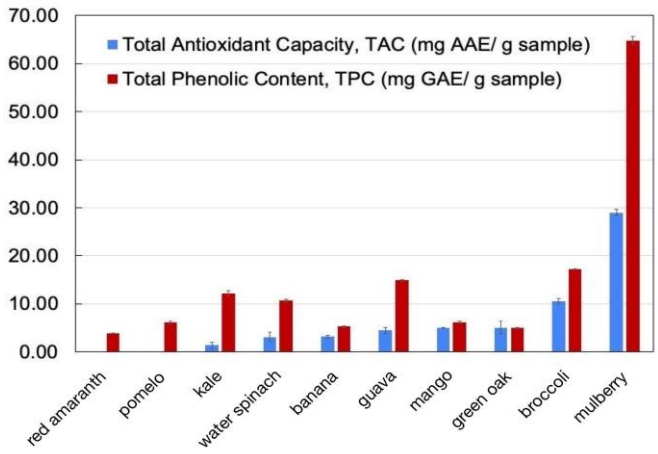

Figure 2. TAC and TPC values of 10 types of fruit smoothies and microgreens smoothies.

CH-08

Release rate of caffeine drug delivery with functionalized UiO-66

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[Background]

Our team learned about MOF in our freshman year of school, and I started to focus on its diversity, and application of the material. MOF are 2-3 dimensional coordination polymers which contain permanent pores within frameworks formed by organic ligands. MOF has high surface area, and it has an ability to construct a desired structure based on coordination chemistry. Also, it can change its pore size by changing the properties or geometry of organic linkers, and can diversify the surface properties by controlling the open metal sites of metal ions inside the clusters. While reviewing the material, I found out that MOFs can be used in drug delivery, which targets a specific cell in our body, enabling the possibility of using it as cancer cure.

[Purpose of the project]

Thus, to lead this theme of medical development, our team decided to reveal the bindng mechanism of drugs to molecule. This project will suggest a way to reveal the MOF-drug interaction, and enable a detailed control of drug release and targeting when commercialized.

[Methodology]

Our team decided to use computational chemistry in order to analyze the structure of the drug molecule and MOFs. First, we selected caffeine as drug molecule because the caffeine structure was easy to calculate, and it shares a similar structure with other drug molecules used in real life. Also, we selected UiO-66 as delivery MOF, since it has high thermal, chemical stability, and the consisting atoms does not cause any cytotoxic activities when degraded. Also, we decided to tag each MOFs with different functional groups to see their effect on the binding, and selected several groups which can induce various interactions between caffeine, such as hydrogen bonding. We checked the drug molecule, caffeine's geometry, electron density, HOMO and LUMO orbital energy and formations. Then, we modeled the small structure of MOF in order to calculate, since we cannot calculate the whole crystalline structure of itself. Then, we optimized the geometry and calculated energy of the molecules via DFT calculation. Finally, we found the docking energy of the two molecule by using Autodock, a program which originally calculates the binding energy in a molecular mechanics level between ligands and protein. Later, to deeply figure out the interaction between caffeine and functionalized UiO-66, we chose other drug molecules with similar geometry with caffeine, such as indole, indene, pyrrole, and repeated the process and checked the results.

[Results of the study]

The results of the calculation with various drug molecule and functionalized MOFs showed the possible positions of caffeine binding into each MOFs with functional groups, and it turned out to be the pi-pi orbital interaction between the rings of caffeine and BDC, a linker of the MOF is the main factor. Also, there were several differences in the binding energy between the MOF and drugs, which might be the effect of the functional groups.

[Conclusion]

We could learn that we can predict the possible binding mechanism by using quantum computation, especially DFT calculation. Also, via Autodock, we could predict the structure of binding between the drug carrying MOFs and the drug molecule, providing a possibility to apply to

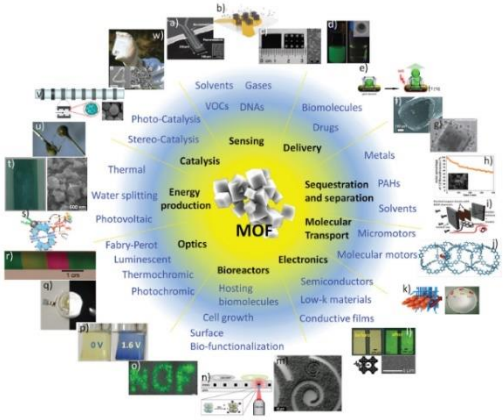
any drug and any kinds of MOF to be used in drug delivery.

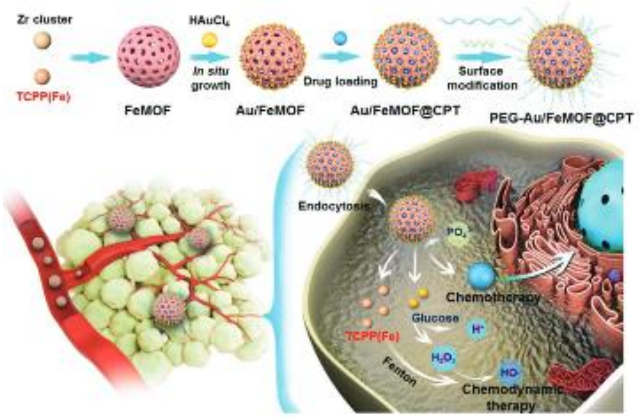
[Future study plan]

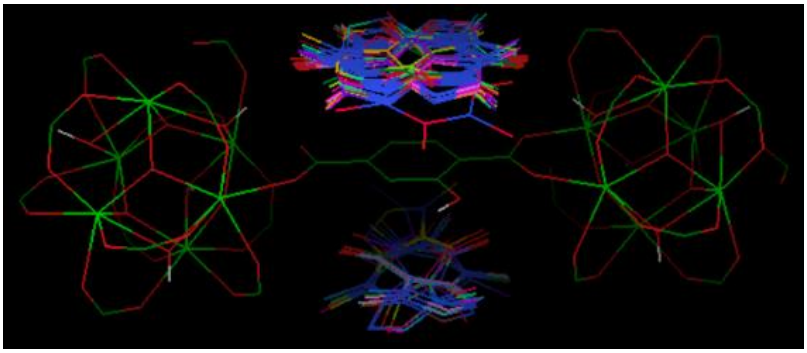
Later, our team will try to carry an experiment to calculate or predict the binding energy by comparing the release rate between different molecules. Our team succeeded in synthesizing the tagged UiO-66s in lab condition, and is in activation process.

[Keywords]

MOF, Coordination Chemistry, Computational Chemistry, DFT calculation, Molecular Mechanics,







CH-09

An indicator biofilm for meat product freshness synthesized from sugarcane bagasse with anthocyanin (extracted) by *Hibiscus sabdariffa*

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[Background]

Anthocyanin extract has an indicator property that can measure the acid-base equilibrium of the solution. Therefore, the feature can be used to inspect or identify the quality of fresh food, due to changes in the pH of the pork affects the quality of the pork. So we have developed a biofilm from sugarcane bagasse, an agricultural by-product, mixed with Anthocyanin extracted from *Hibiscus sabdariffa* to indicate meat/pork freshness

[Purpose of the project]

1. To produce biofilms containing indicator ingredients from *Hibiscus sabdariffa* extract using Carboxymethyl cellulose from Sugarcane Bagasse.
2. To study the color change of indicator-containing biofilms from *Hibiscus sabdariffa* extract in buffer solution.
3. Study on the color change of biofilm developed in perishable foods.

[Methodology]

Prepare Carboxymethyl cellulose by sugarcane bagasse through the process to be a Carboxymethyl cellulose (CMC) powder and extraction of Anthocyanin which pH 1 from Hibiscus sabdariffa to form a bio-indicator film to detect food which is spoilage. There are 4 sets of formulas that differ in the amount of *Hibiscus sabdariffa* in 5, 10, 15, and 20 ml. Then, examine brightness and its colors to choose the best biofilm. Next, study the reaction by colors changing in acid-base and buffer solution pH 1-12 to be tested in perishable food.

[Results of the study]

Part 1 Study on the production of biofilms containing indicators

Sugarcane bagasse fiber synthesized into Carboxymethyl cellulose (CMC) was found to obtain 121.21 % of the initial cellulose weight. The chemical structure of CMC from sugarcane bagasse is the same main group as cellulose by Fourier transform infrared spectroscopy (FT-IR) method. Studying the extraction of Anthocyanin from *Hibiscus sabdariff, we found* that it was equal to 506.80 mg/100 gDw. When it was tested in a buffer solution with pH 1-12, the shade characteristics differed, It was red at pH 1; magenta at pH 3; pinkish-purple at pH 4-6; bluish-green at pH 7-9, and a yellowish-green tint at pH 10-12.

The production of biofilm containing anthocyanin showed that the brightness value (L*), yellow and blue (b*) decrease and red (b*) increases if *Hibiscus sabdariffa* increases. After 10 days, the color of biofilms changes only little. The biofilm formulas C and D with a compound anthocyanin content of 15 and 20 ml caused the film's color to change when dipped in a buffer solution. Therefore, the biofilm formulas c was selected to apply into the indicator biofilm. The color changes in biofilm when it exposed to acid-base vapors with high and low pH. The biofilm blew the same color as the biofilm in the buffer solution.

Part 2 Study on the discoloration of biofilms developed in spoiled food, the results of which study the effectiveness of biofilms in discoloration when applied to pork.

A biofilm from sugarcane bagasse with Anthocyanin from *Hibiscus sabdariffa* changed color from red to greenish brown because the pH is associated with the freshness of the pork and the time during storage.

[Conclusion]

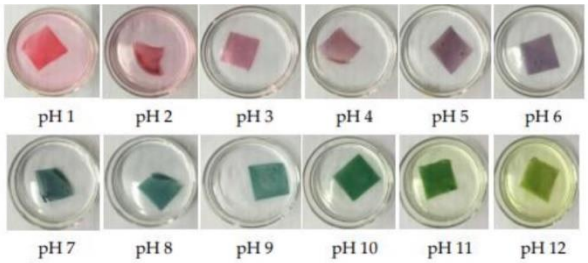
The biofilm from sugarcane bagasse with anthocyanin from Hibiscus sabdariffa developed can be used as an indicator film to indicate spoilage of pork by observing the changes in the color of the biofilm. From the results, A biofilm from Sugarcane Bagasse with Anthocyanin (Extracted) by *Hibiscus sabdariffa* can be used as an indicator to detect spoilage in food.

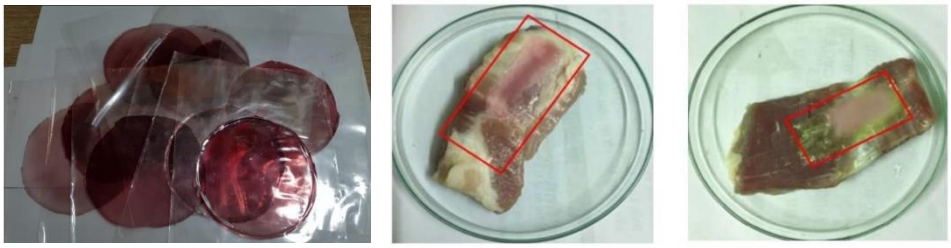
[Future study plan]

It can be developed to be used as an indicator to apply to various industries, for example, used in the agricultural industry, as an indicator measuring pH in the soil. to adjust soil conditions to suit planting or pH measurement to control suitable for aquaculture and it can be used in the food, drinking water, and pharmaceutical industries. pH measurement to monitor chemical reactions in production. Including controlling the quality and taste of food.

[Keywords]

Anthocyanin, Biofilm, Carboxymethyl cellulose





CH-10

Analyzing the contributions of microbial food production technology to the future food crisis

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[Background]

CO_2 is one of the greenhouse gases that is a major factor in global warming. It is considered chronic garbage these days. But in this severe situation, keeping livestock is aggravating global warming. Eating meat from livestock is inevitable, so we need to find new ways to get meat.

[Purpose of the project]

The purpose of the project is to research the chemical production process of microbial food and investigate the ways this technology will be beneficial to future food insecurity. We plan to select several significant factors and analyze the benefits of microbial food compared to the original source of food. The ultimate goal is to explore technology to slow down global warming. As this technology is being actively developed, raising awareness of new scientific methods of preparing for the food crisis and global warming is crucial.

[Methodology]

To analyze the microbial food technology, comparing the efficiency of microbial protein production with that of food like meat will be the appropriate method. As for the comparable factors, water use, land use, the content rate of protein, environmental pollution, and use of pesticides would be possible.

[Results of the study]

In the aspects of water and land use, microbial food is superior to the original source of food. It uses less water and land for the same amount of protein. As for the environment, they do not pollute the environment while foods, such as beef, are harmful to the environment during production. In addition, microbial food has more benefits, such as having more protein per KG, less use of pesticides, etc.

[Conclusion]

Microbial food technology is more efficient and microbial food stands out when it comes to nutritional aspects compared to the original source of food. In addition, it is expected to bring beneficial effects on the environment and edible food as many companies like Solein and Kiverdi are on their way undertaking this task.

[Future study plan]

We plan to analyze precisely in which ways microbial food is preferable to the original source of food. Then, we aim to find possible ways to improve microbial food technology for future society, whether in environmental or technological aspects.

[Keywords]

Microbial food, Protein, Food crisis, Global warming, Livestock, Pesticide

CH-11

The development of shampoo containing phenolic compounds from cashew apple to slow down grey hair process

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[Background]

Grey hair is one of the signs of aging and can worsen self-confidence. The cause of grey hair is the inability of melanocytes to produce melanin, which is a color pigment in hair. Melanin production involves tyrosinase that catalyzes the oxidation of L-tyrosine to dopaquinone, which is a substrate for eumelanin (brown-black) and pheomelanin (yellow-red) synthesis. The decrease in melanin naturally occurs by aging and other factors such as the increase in hydrogen peroxide concentration resulting in melanocyte apoptosis and causes DNA damage. Hydroxyl radicals from hydrogen peroxide can also inhibit tyrosinase activity and affect the process of melanin production, which causes grey hair. According to literatures, phenolic compounds acting as antioxidants can break down hydroxyl radicals and can be found in many plants such as cashew plant, a native perennial plant in northeastern Brazil and mostly found in southern Thailand. Cashew nuts have a great economic value, while cashew apples are not popular and most of them turn into an agricultural waste. In this work, cashew apples were chosen as an ingredient in a developed shampoo for slowing down grey hair.

[Purpose of the project]

To study total phenolic content (TPC) and total antioxidant capacity (TAC) of cashew apple extract, and to develop a shampoo recipe containing cashew apple extract.

[Methodology]

Cashew apples were prepared as powder prior to ethanol extraction at the ratio of 1:10 w/v for three times. The supernatant was collected and evaporated using a rotary evaporator. The extract was then evaluated for total phenolic content (TPC) using Folin-Ciocalteu assay with gallic acid as a standard, and total antioxidant capacity (TAC) using 2,2-diphenyl-1-picryl-hydrazyl-hydrate (DPPH) radical scavenging assay with ascorbic acid as a standard. The extract was then added as an ingredient in a shampoo formula. The physical characteristics of the developed shampoo was compared to that of the control (i.e., shampoo without the extract).

[Results of the study]

The extract obtained from cashew apples was found to be a gooey brown substance. The TPC value of the extract was found to be 29.43 ± 3.92 mg gallic acid equivalent (GAE)/ g cashew apple extract. According to the DPPH assay, the half maximal inhibitory concentration (IC_{50}) of the extract was 282.3 mg ascorbic acid equivalent (AAE)/g of cashew apple extract. The developed shampoo with the addition of 0.25 g extract/50 g shampoo was found to be clear yellowish solution without the smell from the extract; meanwhile, the control was found to be a clear solution. No physical change was observed for both shampoo formula after being kept at room temperature (~30 ^{o}C) for 6 days. The pH values of both shampoo formulas were also found to be around 5-6.

[Conclusion]

According to the total phenolic content and the IC_{50} value of the cashew apple extract, cashew apples were a promising source of phenolic compounds with high antioxidant capacity. This could lead to the ability to scavenge hydroxyl radicals emerging from hydrogen peroxide, one of the causes of grey hair. The developed shampoo containing the cashew apple extract was also found to be stable after being kept for 6 days. This indicated the possibility to make use of cashew apples, an agricultural waste, and to add value to the agricultural product.

[Future study plan]

The next study plan of this project is to perform hydrogen peroxide and tyrosinase scavenging assays of the cashew apple extract to ensure the ability to scavenge hydrogen peroxide and to study the effect of the extract on tyrosinase, respectively. The extract will also be used in a dyeing test with bleached hair. In addition to the shampoo development, the shampoo will be tested for its stability, pH, and hydrogen peroxide scavenging, and will be compared to the normal formula.

[Keywords]

Grey hair, Cashew apple, Phenolic compounds, Hydrogen peroxide scavenging, Tyrosinase

Figure 1. Cashew plant
(source:https://blogs.extension.iastate.edu/answerline/2021/04/13/cashews-not-really-a-nut/)

Figure 2. Normal formula shampoo (left) and the developed shampoo containing the cashew apple extract (right)

CH-12

Synthesis of DNA-binding thiazolopyrimidine systems containing dimethylaminostyryl substituents as fluorescent molecular probes

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[Background]

Fluorescent molecular probes with spectral maximum in red and NIR regions, which are at the same time capable to interact with DNA, usually are of significant interest. These compounds can act as nucleic acid markers to visualize their binding to target DNA or RNA macromolecules.

[Purpose of the project]

The main purpose of the project is to develop a synthetic pathway to a novel type of methine dyes family: azoloazinium systems, containing quaternized nitrogen atom as a bridge and one or two 4-dimethylaminostyryl substituents at α and γ positions relative to the quaternized nitrogen (Fig. 1). These compounds are expected to be used as fluorescent DNA/RNA molecular probes.

[Methodology]

Target compounds were obtained from 2-aminothiazole and its derivatives via by a 3-step synthetic pathway using the methods of organic synthesis (Fig. 2). Purification of compounds was performed by crystallization from appropriate solvents. All synthesized compounds were characterized by NMR spectroscopy.

[Results of the study]

The starting 2-aminothiazoles **1a-d** were converted into target compounds **3a-d** and **4a-d** with good yields (see Fig. 2). We demonstrated, that obtained substances bind with DNA in solutions, forming deeply colored complexes (Fig. 3) and can act as fluorescent cell dyes emitting in the red region (ν=15400 cm^{-1} or less) (Fig. 4). Obtained compounds demonstrated significant antibacterial and antimycotic activity. Compound **4c** were tested on cancer cell lines and demonstrated high cytostatic activity.

[Conclusion]

As a result, we have developed a convenient 3-step synthetic pathway to a novel class of fluorescent DNA probes and obtained 8 new compounds with good yields. Synthesized derivatives demonstrated good fluorescent properties making them suitable for the use in bioimaging.

[Future study plan]

In the future we plan to expand the library of target products. This will be done through the use of new azole and azinium components of the heterocyclic core and new substituents in the styryl side chains. Wider molecular diversity of the synthesized compounds would be used to obtain compounds with desired properties of both DNA probes and biologically active substances with antibiotic and antitumor activity.

[Keywords]
Azoloazinium salts, Fluorescent probes, Antibiotic activity, Cytostatic activity

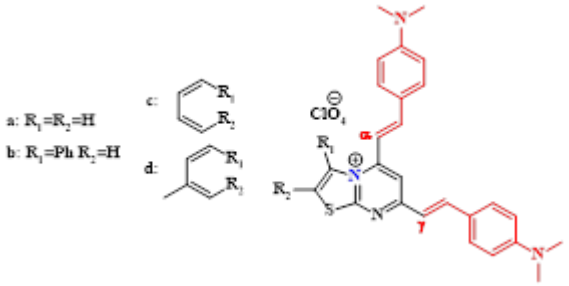
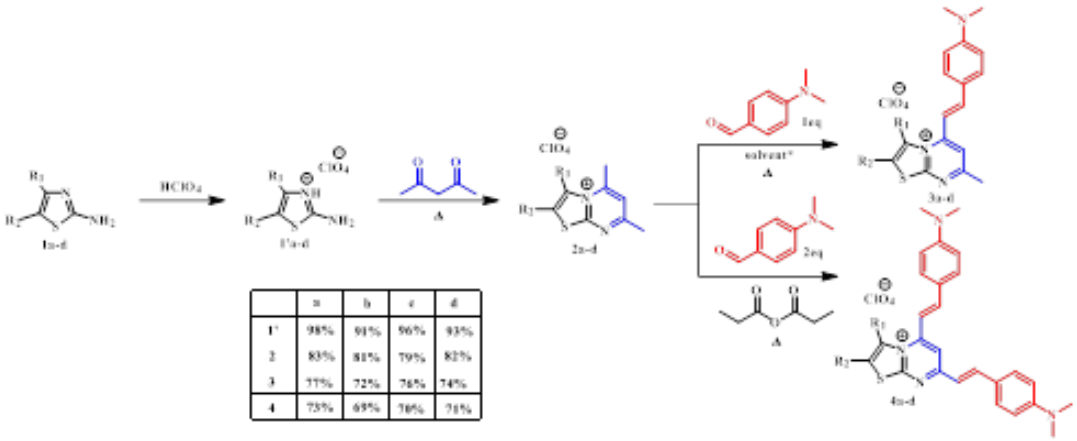


Figure 1: General structure of thiazolopyrimidinium salts containing 4-dimethylaminostyryl substituents.



	a	b	c	d
1	98%	91%	96%	93%
2	83%	81%	79%	82%
3	77%	72%	76%	74%
4	75%	69%	78%	76%

Figure 2: General synthetic approach to mono-substituted **3a-d** and di-substituted **4a-d** thiazolopyrimidinium salts.

Figure 3: aqueous solutions of compound **3c** (left) and its complex with DNA (right)

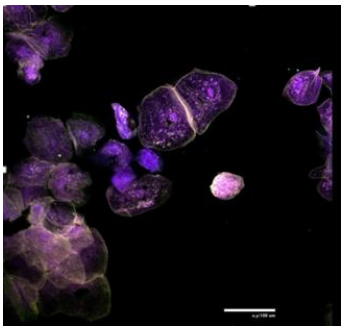


Figure 4: cells of human buccal epithelium stained with **3c**.

CH-13

Development of tri-layer heterostructures for large spin-orbit interaction

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[Background]

As technology advances, data chips and thus capacitors shrink in size, causing such capacitors to leak electrons and lose data over time. As a result, there is a need for advancements in data storage that can store data permanently without sacrificing size, a need that tri-layer heterostructures address. Tri-layer heterostructures uses the intrinsic spin of the electrons in the two ferromagnetic layers of the heterostructure to store data in terms of binary code. By sending charge currents into the heterostructure, the spin of the electrons in the upper ferromagnetic can be changed through spin polarization, changing the data from “0” to “1”.

[Purpose of the project]

The aims and objectives of the research is to determine how different materials of the tri-layer heterostructure would affect the transport of spin current and the charge current to spin inter-conversion efficiency in the heterostructure in which electrons in the charge current and free layer are spin polarized. Platinum, Tantalum, Cobalt, and Permalloy films were analyzed to determine their effect on spin relaxation of tri-layer heterostructures. The thickness of Co layers was varied to change the interface anisotropy. Pt and Ta were also compared as the underlayer while Cu and Pt were compared as the spacer layer to observe their effect on the spin relaxation. Spin Relaxation is the property of interest in the heterostructure as it causes decay of spin polarized electrons. Hence, minimizing spin relaxation within the materials would improve inter-conversion efficiency.

[Methodology]

Magnetron sputtering and ferromagnetic resonance, also known as FMR spectroscopy, were used in this study. Magnetron sputtering is a high-rate vacuum coating technique used to deposit thin films, alloys, and compounds on a wide range of materials. Electrons ionize the argon gas particles, which become trapped in the magnetron's magnetic field. The plasma then bombards the target material, ejecting atoms of the material that will be deposited on the substrate.

FMR spectroscopy was used to obtain the absorbance spectrum of RF signals by samples to investigate the magnetization dynamics. The sample's magnetization will align along the direction of the applied field. The sample is positioned in such a way that the alternating magnetic field produced by the RF current passing through the CPW is perpendicular to the external magnetic field. The magnetization is perturbed into precession by the small alternating magnetic field.

[Results of the study]

Cobalt has negligible effect on the frequency as H resonance increases, indicating that spin pumping of the cobalt layer remains constant regardless of its thickness. The presence of Tantalum and copper would further promote the perpendicular magnetic anisotropy of the permalloy film, resulting in weaker external magnetic field needed in the precession of the samples’ magnetization in the direction of the external field. Platinum enhanced the damping of the precessing magnetization in the permalloy layer. Moreover, the thinner the cobalt layer, the greater the Gilbert Damping of the Sample. There is stronger anisotropy induced in the cobalt layer sandwiched between the tantalum and platinum layer. Lastly, the Gilbert Damping value of the samples containing Cu is lower as compared to the samples containing Pt.

[Conclusion]

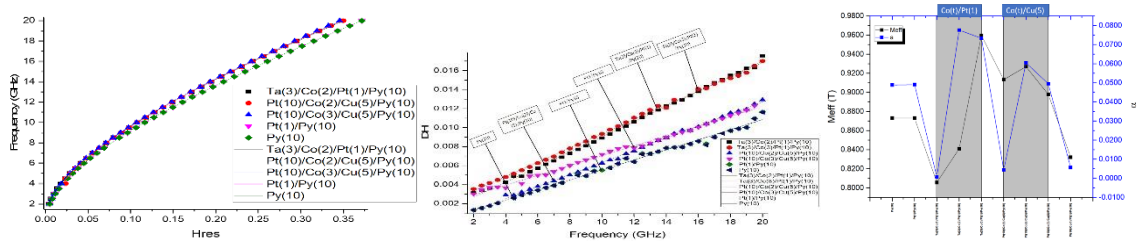
The results show that as the thickness of the Co decreases, there is an increase in the perpendicular magnetic anisotropy which causes effective magnetization to decrease. Ta as an underlayer induces stronger anisotropy of Co and hence has more of an influence on the effective magnetization of the trilayer heterostructure than Pt. Cu as the spacer layer causes the spin relaxation and Gilbert's damping of the heterostructure to be lower compared to Pt.

[Future study plan]

For the future of this project, we can utilize Vibrating Sample Magnetometer (VSM) to find out the magnetic moments of the tri-layer heterostructures. This can be done by doing both in-plane and out-of-plane analysis of the sample, and plotting a multi-plot hysteresis curve to show the magnetization of the sample. Nuclear Magnetic Resonance (NMR) Spectroscopy can also be used to create an observable nuclear spin polarization to directly observe the spin relaxation.

[Keywords]

Magnetic anisotropy, Spin polarization, Spin current, Spin relaxation, Spin diffusion length, Gilbert Damping, Spin Orbit Torque, Effective magnetization, Saturation magnetization, Inhomogeneous broadening, H resonance, Spin pumping



CH-14

Optimization of ultrasound-assisted extraction for *Nelumbo nucifera* petals and its antioxidant activity

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[Background]

Nelumbo nucifera Gaertn. is an aquatic plant in the Nelumbonaceae family. Its petals contain many bioactive components and has many pharmacological activities such as antidepressant, antioxidant, anticancer, etc.

[Purpose of the project]

This study aimed to optimize the conditions of ultrasound-assisted extraction (UAE) techniques for the extraction of *N. nucifera* petals. Total phenolic content (TPC) and total flavonoid content (TFC) were tested by colorimetry and total anthocyanin content (TAC) was analyzed by pH-differential method. Antioxidant activity was also determined by DPPH radical scavenging assay.

[Methodology]

Define the factors to differentiate conditions included 17 experiments, extract the important substances by UAE, test to find TAC, TPC, TFC and antioxidant by DPPH, summarize and compare the results of each run.

[Results of the study]

The highest percentage extraction yield (16%) was found at the condition of temperature (40 °C), extraction time (45 minutes) and the material-to-solvent ratio (1:3 g/mL). The highest TPC (94.41mg Gallic acid equivalent/g extract) was found at temperature (50 °C), extraction time (60 minutes) and material-to-solvent ratio (1:3 g/mL). The highest TFC (110.28 mg quercetin equivalent/g extract) was found at temperature (60 °C), extraction time (45 minutes) and material-to-solvent ratio (1:3 g/mL). The highest TAC (1.17 mg cyanidin-3-glucoside equivalent/g extract) was found at temperature (40 °C), extraction time (45 minutes) and material-to-solvent ratio (1:3 g/mL). The highest antioxidant activity by DPPH was shown by IC_{50} of 73.91 µM.

[Conclusion]

The optimum conditions for each phytochemical content could be used for the product development of *N. nucifera* petals.

[Future study plan]

For a short-term period, to investigate the most appropriate condition that provide the number of important substances. For a long-term period, to develop the most extracted one for Thai traditional medicine and health products.

[Keywords]

Ultrasound-assisted extraction, *Nelumbo nucifera*, Antioxidant, Phenolic, Flavonoid, Anthocyanin

Pipetting the solution of Ethanol to find TAC.

Weighing the substance of *Nelumbo nucifera* petal powder.

CH-15

CARBOXAN: ZnONP loaded carboxymethylcellulose/chitosan (CMC-CS) nanocomposite solution from Azolla and Philippine Diadema savignyi (Blue-Eyed Sea Urchin) as novel coating material for banana fruit

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[Background]

Banana is one of the major principal food resources in the world occupying the fourth world rank of the most significant foodstuffs after rice, corn, and milk (INIBAP, 2003). In the Philippines, MIMAROPA Region produced 31, 170 mt and 22, 172 mt of banana in 2015 and 2016 respectively (PSA, 2016) wherein, Oriental Mindoro accounted for the bulk of 87% of the total banana production in the region (Bathan & Lantican, 2010). But then, local banana farmers recently faced problems whenever they transport the fruit due to rapid ripening which caused a serious decline on their income and profit.

Postharvest loss of banana is one of the major problems globally. Bananas are usually harvested before fully mature for domestic consumption. Usually, bananas are stored at room temperature. During storage, banana fruit is easily deteriorated due to the quick ripening process. Such spoilage can occur either during transportation or in the market resulting considerable economic loss to farmers, importer, and retailers (Hossain & Iqbal, 2016). On the other hand, there is a rapid invasion of sea urchin species in the shallow part near the local shores of Bulalacao, Oriental Mindoro, Philippines.

According to Suseno et al. (2014), the application of chitosan coatings which can be derived from crustaceans and marine shells is a potent material in improving the quality and extending shelf-life of fruits. Meanwhile, carboxymethylcellulose (CMC) is one of the most promising cellulose derivatives which is now widely used in various advanced application fields, such as food, paper, textile, and pharmaceutical industries.

[Purpose of the project]

This study developed a potential solution to the rapid ripening of bananas through a nanocomposite coating solution made from the derived chitosan of the tests/shells of Philippine *Diadema savignyi* Michelin, 1845 and carboxymethylcellulose (CMC) from *Azolla pinnata* along with ZnONPs.

[Methodology]

The Philippine *Diadema savignyi* Michelin, 1845 tests and *Azolla pinnata* were collected, cleaned, and prepared for the chitosan and carboxymethylcellulose derivation. The production of the chitosan powder was executed following the standardized procedures of Majekodunmi, Olorunsola, Ofiwe, Udobre and Akpan (2017) while the CMC was obtained following the protocols presented by Rachtanapun (2010) with few modifications. Meanwhile, the ZnONP solution prepared at the ratio of 500mg/ml. The derived chitosan and CMC were characterized using FT-IR and SEM while the ZnONP samples were evaluated using EDS. In coating the banana samples with CARBOXAN, 0.5% (w/v) chitosan solution was prepared by dissolving 5 grams of chitosan into the solution of 0.5% (v/v) acetic acid mixed with 0.5% CMC (w/v) with 25% glycerol as plasticizer and mixed with ZnONPs solution (100mg/mL) (Park *et al.,* 2004) under vigorous stirring and was filtered to remove insoluble materials. The bananas were evaluated for their weight loss, firmness, color, and disease incidence. In analyzing the data, t-Test was used with significance threshold of 0.05.

[Results of the study]

The results of the study show that the derived chitosan has degree of acetylation of 35.65%, 70% solubility and 6.5 pH. Its SEM results revealed an amorphous and non-homogenous structure. Meanwhile, the FT-IR results of the CMC showed the characteristic peaks of carbohydrate and confirmed the carboxymethyl substituent at the CMC backbone. Moreover, the SEM-EDS of the ZnONPs showed spherical morphologies and average particle size of 52 nm demonstrating highest energy peak for zinc (9.6 keV). In addition, CARBOXAN-coated banana samples (*n=10*) stored under bamboo fruit storage chamber revealed lower weight loss containing green portions with yielding softness and 90% disease incidence after the seven-day observation as compared to the uncoated samples that were soft, yellow with brown spots gaining higher weight loss and 100% disease occurrence.

[Conclusion]

This study proves that the derived CARBOXAN coating solution from the chitosan of sea urchins and carboxymethylcellulose of *Azolla* with the integration of ZnONPs is a potent natural material in delaying the rapid ripening of the *Musa x paradisiaca* (Saba banana). This study could serve as a good response to the increasing occurrence of food wastes due to ripening acceleration in the agriculture sector.

[Future study plan]

Further studies must be conducted to test the full capacity of the CARBOXAN coating solution in prolonging the shelf life of the fruit at longer time of observation.

[Keywords]

Ripening delay, Carboxan, Sea urchin chitosan, Azolla CMC, Fruit coating, Biopolymers

CH-16

Development and synthesis of B-group provitamins capable of passing through the cell membrane in case of SLC5A6 gene mutation

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[Background]

Sodium-dependent multivitamin transporter (SMVT) is an important transporter of B-group vitamins, such as biotin, pantothenic acid, and lipoic acid. SMVT protein, which is encoded by the SLC5A6 gene, regulates the transport of vitamins through the cell membrane, including their passing through a blood-brain barrier. In case of biallelic mutations in SLC5A6 gene the transportation of vitamins is troubled, which causes metabolic disorder, leading to neurodegenerative disorders and physical depression of the body. Injection of vitamins as a treatment is hardly effective due to the low permeability of cell membranes. Prodrug usage could be an alternative method of B vitamins delivery.

[Purpose of the project]

The main purpose of this study is to synthesize a number of conjugates of the B_7 vitamin (biotin) and the ligand-transporters. The conjugates would allow the capture of provitamins by cells via alternative cell transport channel.

[Methodology]

We chose several strategies based on different transport channels. The target synthetic structures (Figure 1) were:

- conjugate **1** containing a phenylalanine fragment, that can be transported across the cell membrane using the LAT1 transporter;
- conjugate **2** containing a fragment of galactose, that is absorbed by the cell using the SGLT1 cotransporter (Na^+-dependent glucose and galactose transport channel);

compounds **3** and **4**, which are capable of being absorbed into the cell passively without the participation of special proteins.

[Results of the study]

Target compounds **1** and **2** were prepared in 2 and 4 steps with 98% and 7% yields, **3**-**4** were synthesized from biotin in 1 step with 85% and 95% yields. All synthesized compounds were characterized by the NMR spectroscopy and mass spectrometry and are to be tested on the cell lines with SLC5A6 gene knockout.

[Conclusion]

As a result, we have developed a synthetic strategy to obtain four new biotin conjugates with good yields from commercially available compounds – perspective provitamin candidates for SLC5A6 gene mutation condition treatment.

[Future study plan]

Future study plans include the tests of the obtained conjugates on cell lines with the SLC5A6 gene knockout and further development of new provitamin candidates.

[Keywords]
Transport channels, Vitamins, SLC5A6 gene, Provitamins

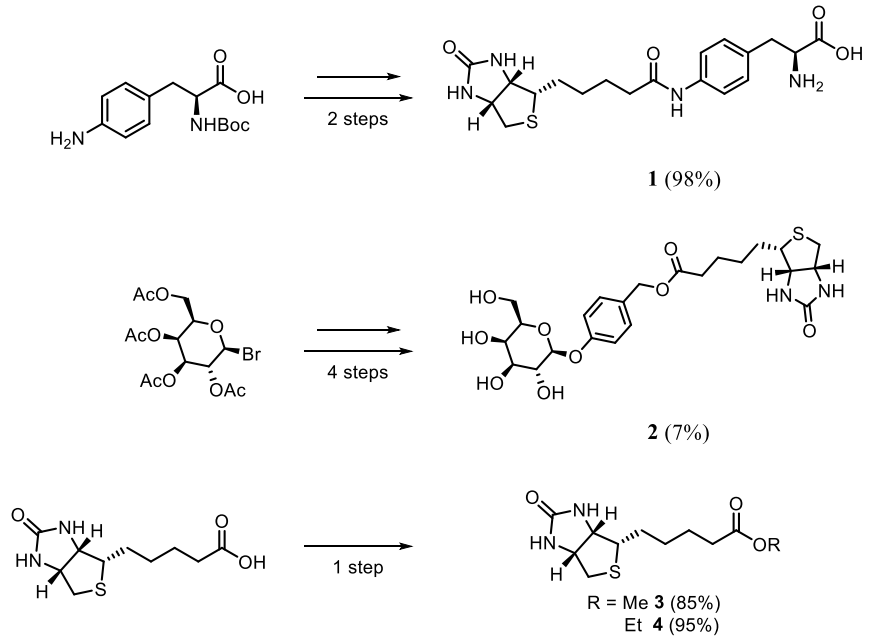

Figure 1: Structures of synthesized compounds **1**-**4**.

CH-17

Development of bioplastics from starch for indicating spoilage of food

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[Background]

Nowadays, the development of bioplastics has many variations to suit the purpose and reduce the cost. The aim of the research was to develop a bioplastic film from inexpensive and attainable materials, and also to add indicator properties to the bioplastic for measuring food spoilage.

[Purpose of the project]

To synthesize bioplastics from starch for food spoilage measurement

[Methodology]

The bioplastic can be made using 7 grams of rice starch, 3 grams of cornstarch, 2 grams of gelatin, and 2 grams of glycerol as a plasticizer. Then add 100 grams of water and boil the mixture at 240°C. After that, pour the mixture onto a plastic tray and wait 3 days for the plastic to dry. In addition to using pure water, add anthocyanin extract from dried Asian pigeon wing flower (*Clitoria ternatea*) to measure food spoilage. The physical properties of the film such as tensile strength and ultimate strain were measured using universal testing machines. And a structural property test was done using the IR Spectroscopy method. Then the film was employed with different pH solutions to evaluate indicator properties of the bioplastics, and then used to indicate the spoilage of food such as shrimps. The indicator properties were tested by putting raw shrimp in a box and the bioplastic on the lid of the box.

[Results of the study]

The IR-spectrum from FTIR spectroscopy shows that the basic structure of the film is similar, but the magenta film has the carboxyl function (-COOH) from the citric acid. The results of physical property tests such as ultimate tensile strength and ultimate strain show that the tensile strength of the film without citric acid is higher than that with citric acid. Therefore, the film can be applied to measure the spoilage of food. By testing the spoilage of shrimp, the results show that both films turned green after 12 hours, but the color change in the citric acid-induced film is more evident.

[Conclusion]

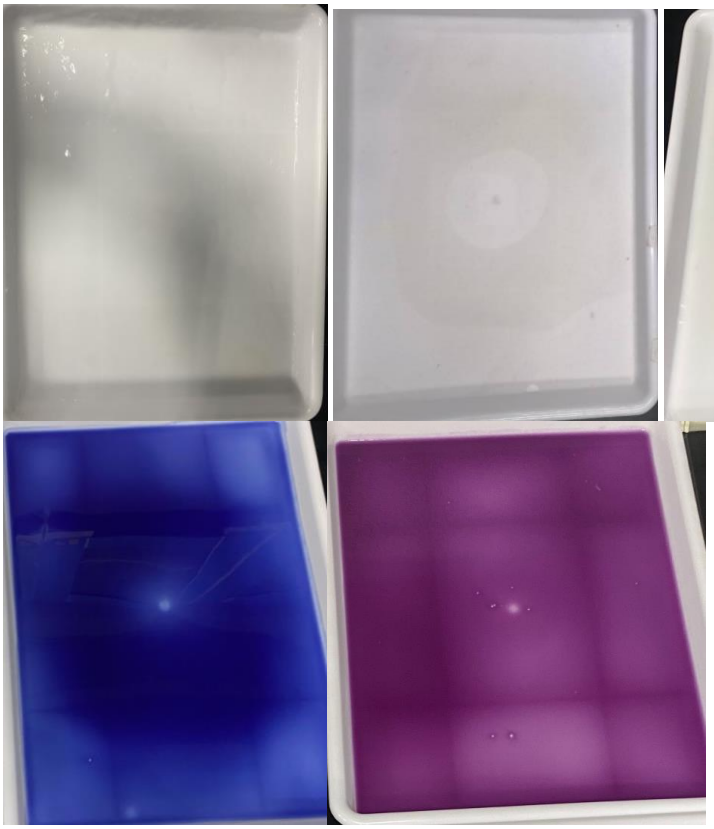
Bioplastics from rice flour and cornstarch can be synthesized using glycerol as a plasticizer and enhanced as an indicator to measure food spoilage by using butterfly pea, which contains the main component of anthocyanin. From the analysis of film properties, the average thickness of the film was about 0.08 mm. And when tested for the tensile strength of plastic, it was approximately 57.3 MPa, which was suitable for use in packaging. When tested with various pH solutions, the film has an indicator property that will change the color from the original blue or purple to turn green when it comes in contact with a base solution. In the same way, the film can be applied to food spoilage. Because when food spoils, it releases amides, which have basic properties.

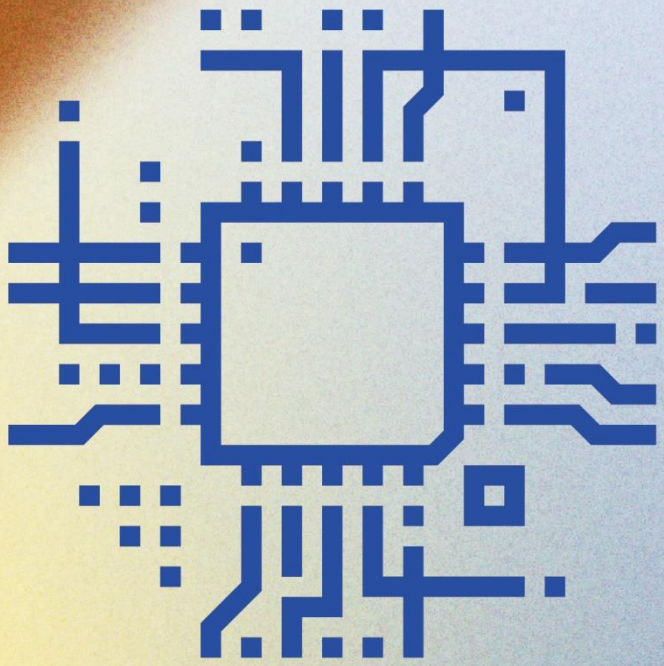
[Future study plan]

If more experiments are possible, additional control variables should be defined as well as testing with a larger number of samples to reduce the discrepancy between the experimental results. This project can be further studied by improving the performance of the film such as water resistance, improvement of film to be used for various food packages, or using a different plasticizer.

[Keywords]
Plastic problem, Bioplastic, Indicator, Spoilage of food, Starch

Images of different film types





Computer Science

CO-01

Comparison of the temperature distribution in human eye during treatment with IPL and Laser techniques: Numerical simulation

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[Background]

Intense pulsed light (IPL) is one of the treatment methods for Meibomian gland dysfunction (MGD). The heat from the light energy stimulates the meibomian gland to improve the function of the meibomian gland. However, the laser is also one of the medical treatment methods that have a similar principle. This raised the interesting question of which technology is more effective for treating dry eye problems. However, The human eye is a complex and sensitive organism, and experimental and practical studies cannot be applied to the human eye. Therefore, a mathematical model is necessary.

[Purpose of the project]

This study presented the comparison of dry eye treatment with IPL and laser techniques by using a numerical simulation.

[Methodology]

This study presented the comparison of dry eye treatment with IPL and laser techniques by using a numerical simulation. The 2D mathematical model of human eye was developed based on the bioheat equation couple with Beer-Lambert equation. The set of these equations is solved using the finite element method (FEM). Study on the simulation of one pulsed IPL light with power 15 J/cm^2 in 3.5 ms and cut off filter at 590 nm. Likewise, laser wavelength is 590 nm with the same energy and exposure time. For the model accuracy, this mathematical model validated to the experimental results by Myhill et al. with the same conditions. Verification results were clearly in good agreement with the experimental results and gave confidence in the accuracy of the presented numerical models.

[Results of the study]

The temperature distribution in the human eye during the treatment with the IPL and Laser is different distribution. Due to the characteristic of treatment techniques being different. The laser is a focused beam as a monochromatic wave, but IPL is a widely ranged spectrum, so the results of the two techniques are different. However, the results of the laser treatment could be used for MGD with specific conditions.

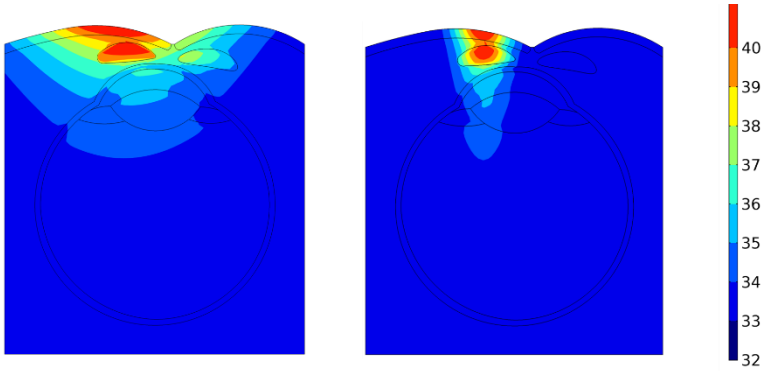
[Conclusion]

According to the numerical simulation results of the temperature distribution in human eye during MGD treatment with IPL and laser, laser might be able to treat MGD as well as IPL but it require the appropriate specific condition.

[Future study plan]

In future work, we will plan to develop a 3D mathematical model of the human eye for MGD treatment with IPL or Laser. And bring the light transport equation for predicting the light distribution of the human eye during the MGD treatment with IPL or Laser to improve the model accuracy as fundamental knowledge of the dry eye treatment with IPL and laser as guidelines for practical treatment design.

[Keywords]
Intense pulsed light (IPL), Laser, Dry eye, Heat transfer, Numerical simulation, Meibomian gland dysfunction (MGD).



(a) (b)

2D temperature distribution in the human eye during IPL and Laser treatment with the light energy of 15 J/cm^2 at treatment time of 14 ms ; (a) IPL treatment technique, (b) Laser treatment technique

CO-02

A study of supervised learning for human pose classification with 3D skeleton model

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[Background]

Falling can happen to anybody, even physically fit people, especially the elderly. It was found that up to 5% of those who fell were unable to help themselves, and falling is the most common accident that happens in any household, whether it would be a slip, stumble on a plain surface or stumble on a slope, because there are many factors like eyesight and hearing for example and falling can be a reason for hip fracture and brain damage. It can even result in disability or even death in some circumstances.

[Purpose of the project]

The developer has seen the problems regard this situation and then decided to develop a Study and Development of Fall Detection System using 3D Human Skeleton Model. The system, however, struggles to detect some gestures which are similar to both falling and not falling which make the developer wants to improve the project by using machine learning to classify the gestures that the old system struggle to increase the performance.

[Methodology]

The processes for human gesture detection can be described as follows:

1. Import Dataset: Download open-source dataset from “Multiple cameras fall dataset” research by E. Auvinet, C. Rougier, J. Meunier, A. St-Arnaud and J. Rousseau (2010) which consisted of 24 sets of fall and non-fall gestures and 8 different camera angles in total of 9773 data
2. Skeleton Detection: OpenCV and Mediapipe (python’s external packages) will process data from dataset frame by frame to convert to 3D skeleton model data.
3. Gesture detection Algorithms: There are 2 algorithms to detect human gestures.
   3.1 Algo 1: Calculate ratio by dividing width over height of the bounding box from 3D skeleton model
   3.2 Algo 2: Firstly, background segment a frame then divides a frame to 4 segments, and calculate the ratio (FI) of left and right areas to whole area
4. Label Data: Write ratio value (from Algo 1), FI (from Algo 2) and gesture that a person is doing to a comma-separated values (.csv) file. This will happen only if a person is standing up, falling, crouching, or sitting.
5. Import Data: Import csv file from Step 4 to Google Colaboratory
6. Classify with Machine Learning: Compare each Machine Learning which consisted of k-Nearest Neighbor (k-NN), Random Forest (RF), Support Vector Machine (SVM) Linear kernel, Radial Basis Function (RBF) kernel and Polynomial kernel. Separate data into 2 types: one for the training section using 80% of the dataset, and another for the testing section using 20% of the dataset to classify 4 gestures which are standing up, falling, crouching, and sitting

[Results of the study]

According to the table, it can be seen that RF (let amount of decision trees [n_estimators] are 1000) has the highest accuracy with 98.77% from testing with 1955 data (Standing Up: 1594 data, Falling: 78 data, Crouching: 101 data, and Sitting 182 data).

Machine Learning	Precision	Recall	F1-Score	Accuracy
k-NN	0.9769	0.9829	0.9799	0.9806
RF	0.9891	0.9841	0.9865	0.9877
SVM linear	0.9427	0.9496	0.9461	0.9478
SVM RBF	0.9636	0.9683	0.9659	0.9668
SVM Polynomial	0.9783	0.9802	0.9792	0.9785

[Conclusion]

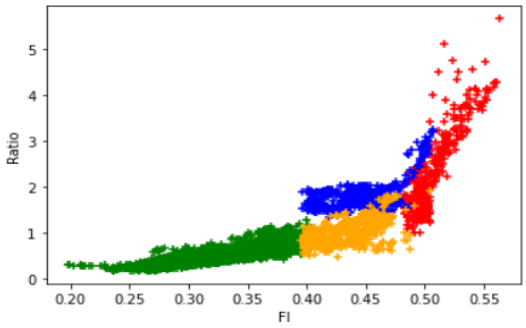
From the experiment tested by using an open-source dataset with our program that we develop, the results showed that of all the 5 types of supervised learning that we use, RF (Random Forest) has the best result with 98.77% which is highly accurate. This system can also be implemented in real life cameras like CCTV cameras in public areas such as hospitals, parks or any living quarter to reduce the damage from falling and potentially saving many lives.

[Future study plan]

1. Including more gestures to classify
2. Increase dataset use for training
3. Using different types of machine learning

[Keywords]

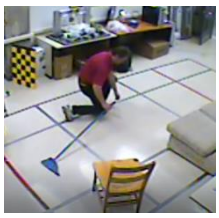
Fall detection, 3D Human Skeleton Model, Machine learning



NOTE: Color for each gesture

Green: Standing Up

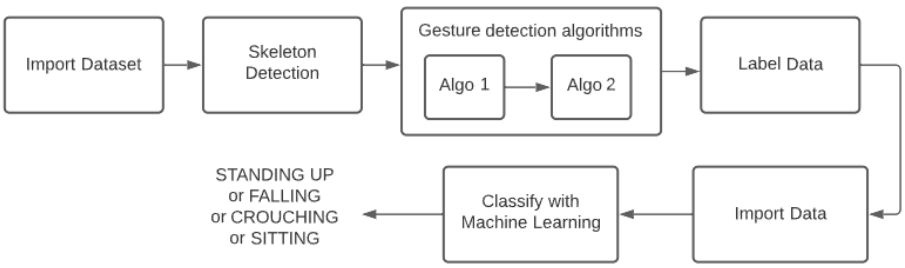
Red: Falling



Blue: Crouching

Orange: Sitting

This diagram illustrates project's methodology.



CO-03

Development of a neural network for classifying selected fabaceae family plant leaves

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[Background]

Plant identification is traditionally an essential manual process taking time and effort, often done with identification keys. While software applications have been developed for plant identification, they have had difficulty with complex image backgrounds and often require internet connection. Convolutional neural networks (CNNs) can potentially improve on these applications due to their high effectiveness in image classification.

[Purpose of the project]

This study aimed to develop and evaluate the performance of a CNN which can identify the leaves of 15 species in the Fabaceae family, including commonly found or native Philippine plants. The study also aimed to import this CNN into a simple Android application. With this, the process becomes more convenient, removing the need for identification keys and allowing users to identify plant species based on leaves.

[Methodology]

Through photography and an online database, 7,880 leaf images were procured then randomly divided in a 70%-15%-15% ratio representing the training, validation, and testing datasets. The neural network was set up through Python, TensorFlow, and Keras using transfer learning, with ResNet-50 serving as the base model. The CNN was trained and validated simultaneously using the respective subsets for 150 epochs. The CNN was finally ported to a simple offline Android application using Android Studio and TensorFlow Lite.

[Results of the study]

Upon testing, the CNN had an accuracy of 78.66%. The weighted metrics of precision, recall, and F1-score were calculated to be 80%, 79%, and 78%, respectively. Using a confusion matrix to tally common misclassifications, *Afzelia rhomboidea*, *Intsia bijuga*, and *Pisum sativum* were found to be most accurately classified. Meanwhile, highly morphologically similar plants, such as those from the same genus, caused most misclassifications. For the application, plant leaf images may be selected through either the smartphone camera or gallery. The CNN then identifies the top 3 species for which it thinks the plant belongs to. This classification is done without an internet connection and with no need to have plain image backgrounds.

[Conclusion]

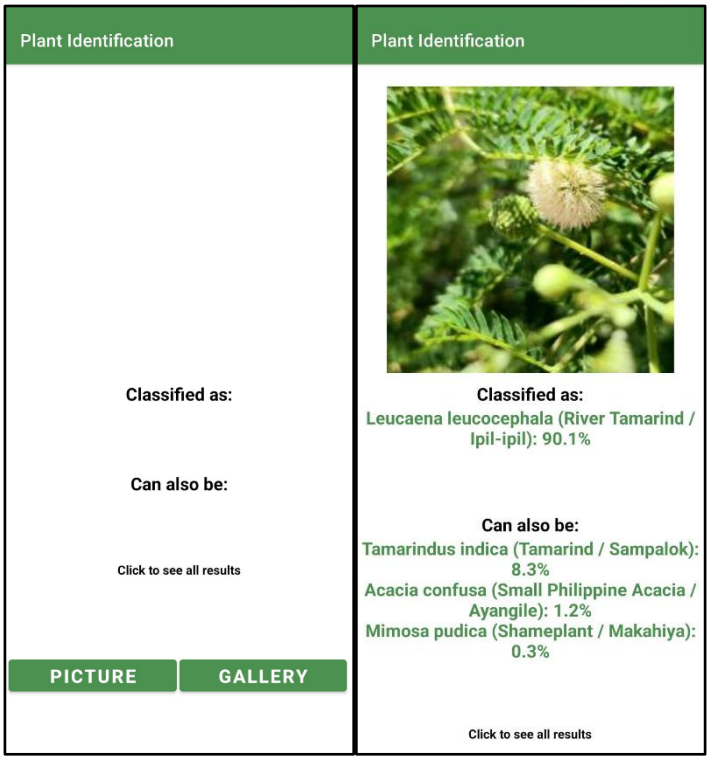
The findings show that a CNN for Fabaceae leaf identification can be a potential alternative to manual identification, including in the context of images from a natural environment. In a mobile application form, CNNs may reduce the need for keys, prior botanical knowledge, or other tools used for identification.

[Future study plan]

Further work may increase the dataset size and include more plant species to better support the native flora of the Philippines. The application may also be improved by taking user feedback for the interface, utilizing user-taken images as additional training data, and implementing geolocation.

[Keywords]
Android application, Convolutional neural network, Fabaceae, Leaf identification, Machine learning, ResNet, TensorFlow, Transfer learning

Images of the developed app's interface before (left) and after classification (right)



CO-04

Diagnosis application for Parkinson's disease by hand tremor analysis

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[Background]

Parkinson's disease is a neurological disease that occurs in a large number of elders around the world. It is caused by the death of the patient's brain cells, which makes the patient have slower movements and tremors, in some cases including constipation, depression, and anxiety. These symptoms severely affect the daily lives of patients. Thailand and many other countries are developing into aging societies, which means there will be more patients with Parkinson's disease around the world. Even though there is no cure for Parkinson's disease, early treatment can help slow down the advance of the disease. However, many Parkinson's patients are diagnosed too late. A diagnosis application for Parkinson's disease by hand tremor analysis was made to help patients acknowledge and receive treatment earlier for their health and quality of life.

[Purpose of the project]

To develop a user-friendly mobile application for elders and their caretakers to diagnose Parkinson's disease by themselves, resulting in early acknowledgment and treatment.

[Methodology]

1. Develop an AI for hand tracking using Visual Studio Code that can collect hand position and changes in hand position.
2. Research a hand tremor analysis model that can distinguish between healthy people, people with nervous system abnormalities, and people with Parkinson's disease by using AI trained to detect hand movements in video of all three types of subjects.
3. Increase the precision of the selected model to 90%.
4. Create a user-friendly application for diagnosing Parkinson's disease by hand tremor analysis that can also assess the risk of Parkinson's disease by questionnaire and report the result to respondents.
5. Test the application with ordinary people and elders, collect their comments, and adjust the application to its best shape.

[Results of the study]

The preliminary hand tremor analysis model can identify healthy people and people with abnormalities in the nervous system with a precision of 86% and can identify healthy people, people with abnormalities in the nervous system, and people with Parkinson's disease with a precision of 57% in real-time analysis.

[Conclusion]

There are possibilities for creating an AI that can diagnose Parkinson's disease by hand tremor analysis, which could result in an increase in the number of patients receiving early Parkinson's disease treatment and a decrease in the number of patients with severe Parkinson's disease.

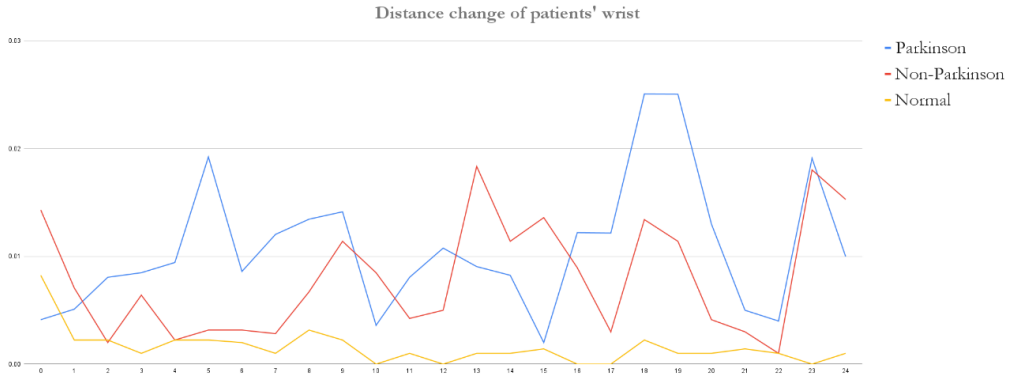
[Future study plan]

1. To collect more video materials for model training to increase the precision of the model to 90% by collecting information from Parkinson's disease patients and other nervous system-related patients who volunteer for the study.

2. To create a diagnosis application for Parkinson's disease by hand tremor analysis with the ability to assess the risk of Parkinson's disease by questionnaire and report the result to respondents.

[Keywords]
Parkinson's disease, Tremors, Mobile application, Elders, AI

Distance change of patients' wrist in one example



X-axis Value	Distance change from...
0	frame 1-3 to frame 4-6
1	frame 4-6 to frame 7-9
2	frame 7-9 to frame 10-12
3	frame 10-12 to frame 13-15
4	frame 13-15 to frame 16-18
5	frame 16-18 to frame 19-21
6	frame 19-21 to frame 22-24
7	frame 22-24 to frame 25-27
8	frame 25-27 to frame 28-30

X-axis Value	Distance change from...
9	frame 28-30 to frame 31-33
10	frame 31-33 to frame 34-36
11	frame 34-36 to frame 37-39
12	frame 37-39 to frame 40-42
13	frame 40-42 to frame 43-45
14	frame 43-45 to frame 46-48
15	frame 46-48 to frame 49-51
16	frame 49-51 to frame 52-54

X-axis Value	Distance change from...
17	frame 52-54 to frame 55-57
18	frame 55-57 to frame 58-60
19	frame 58-60 to frame 61-63
20	frame 61-63 to frame 64-66
21	frame 64-66 to frame 67-69
22	frame 67-69 to frame 70-72
23	frame 70-72 to frame 73-75
24	frame 73-75 to frame 76-78

e.g. index 3 on X-axis means distance change from frame 10-12 to frame 13-15

CO-05

Negative Filter: browser plugin for Thai Twitter sentiment analysis

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[Background]

Sentiment analysis is an approach to identifying the emotional tone behind a body of text. It categorizes sentiment pieces of text as positive, neutral, or negative. So, sentiment analysis can be used to analyze people's feelings, understand others' habits, and use its results to improve one's company by effectively satisfying their needs.

A browser plugin is a small software module for customizing a web browser. Browsers typically allow a variety of extensions, including cookie management, ad blocking, and the custom scripting and styling of web pages. The strengths of the browser plugin are that users can install and learn how to use it easily.

We realize the importance of sentiment analysis and a browser plugin, so we plan to build a program that can analyze messages from social media. Machine Learning, which is an approach to making systems learn without being explicitly programmed to do so, can be used as a method to categorize the sentiment of texts. This application will focus on accuracy of categorizing the messages and usability.

[Purpose of the project]

Negative Filter is a browser plugin that has the feature of filtering negative messages from a user's Twitter feed. This application can classify whether the sentiment of text is positive, neutral, or negative. The dataset is only limited to the Thai language.
The objectives of this project are as follows:

1. Filter negative messages on users' feed that might make them feel bad or depressed.
2. Improve users' experience when using Twitter.
3. Improve Twitter's society by demoting negative messages.

[Methodology]

1. Gather messages from Twitter and categorize messages into positive, negative, or neutral. Then, put them into the Excel file.
2. Clean and improve data quality. For example, delete some meaningless characters, and fix typos.
3. Train models with the following algorithms: Naive Bayes, Random Forest, and Transfer Learning.
4. Choose the best model and build an application, a browser plugin that can be used directly on Twitter.

[Results of the study]

After classifying 3531 texts we had gathered, there are 842 negative texts (24%), 1062 neutral texts (30%), and 1627 positive texts (46%). The classification criterion is to let three people decide what is the text's sentiment and then use the majority of the answers.

The results of three different models of Naive Bayes, Random Forest, and Transfer Learning are 60%, 66%, and 83% accuracy, respectively.

The performance of a different number of concurrent users is shown in Table. 1.

[Conclusion]

Out of the three models, the best algorithm is Transfer Learning, which achieves 83% accuracy. The secondary algorithm is Random Forest, which achieves 66% accuracy. The tertiary algorithm is Naive Bayes, which achieves 60% accuracy. From the results of the application performance test, if more users are requesting the server, the server will take longer to respond. If 100 users are requesting the server, the average response time is 2 seconds and the longest is 4.1 seconds.

[Future study plan]

1. Users can trigger the button to show filtered negative messages.
2. Provide negativity threshold feature for users' preference.
3. Support the English language.

[Keywords]
Sentiment Analysis, Machine Learning, Chrome Extension, API, Transfer Learning

Number of concurrent users	Average time (s)	Min time (s)	Max time (s)	Standard deviation (σ)
10	0.524	0.309	0.758	179.73
20	0.773	0.318	1.410	335.39
30	0.923	0.312	1.688	350.43
40	1.060	0.311	1.901	518.16
50	1.339	0.446	2.760	608.93
100	2.081	0.323	4.169	997.81

Table 1. Evaluation of Transfer Learning's model

CO-06

The Development of artificial intelligence system to detect *Mycobacterium Tuberculosis* (*M. Tuberculosis*) from sputum with Acid-Fast Bacillus (AFB) method

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[Background]

Pulmonary tuberculosis is an infectious disease caused by a bacterium called Mycobacterium tuberculosis (*M. Tuberculosis*), which is spread through airborne transmission. In Thailand, according to the Department of Disease Control. The Ministry of Health found that pulmonary tuberculosis is an infectious disease that still has outbreaks and has a large number of people infected. There are 2 methods of pulmonary tuberculosis detection: 1. Skin tuberculosis (rarely used in Thailand) 2. Acid Fast Bacilli Smear Test from Sputum, for which this method is highly respected and reliable in Thailand. Done by staining and inspecting the sputum sample under the microscope which the positive test would stain the *M. Tuberculosis* pink. But due to the lacking number of microbes in a smear sample, there is a chance that *M. Tuberculosis* couldn't be found in that particular area of the slide so the other areas must also be inspected to confirm TB infection too which makes the process longer so if there's a solution to reduce the *M. Tuberculosis* inspection process, it would also make the whole AFB process more convenient for the physician.

[Purpose of the project]

The purpose of the project is to develop a system to detect *M. Tuberculosis* in the sputum sample by using AFB method, making the process simpler and less time-consuming for physician.

[Methodology]

In developing the *M. Tuberculosis* detection system, firstly, develop the Neural Network model by using Python and Python library. Secondly, prepare the sputum datasets from confirmed positive tuberculosis patients in the hospital by doctors, but due to the limitations in accessing the data, the researchers have to prepare the datasets from a reliable source on the internet instead. Thirdly, train the Neural Network model from the prepared dataset with the Yolov5 model, a CNN model that is good for training object detection. Lastly, evaluate the accuracy of the trained model by testing 610 MTB detection results whether if they match with the actual results.

[Results of the study]

The system can accurately detect MTB in the sample slide. By the accuracy score, the system makes 0.969 F1 score. In the addition, the system's average detection time is 71.013 milliseconds

[Conclusion]

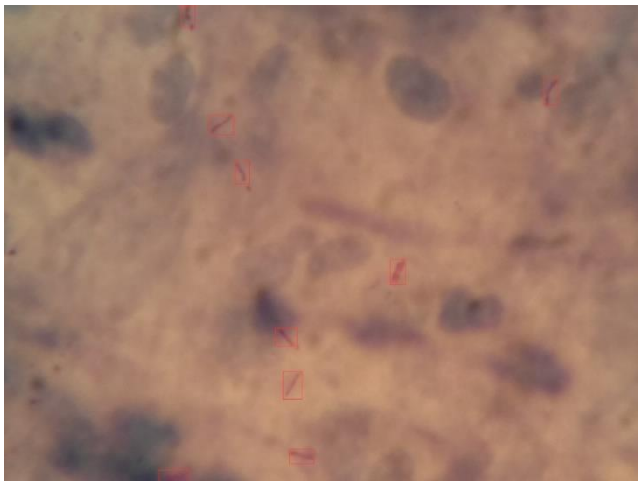
In conclusion, the *M. Tuberculosis* detection system can accurately detect *M. Tuberculosis* in the picture of the given sample slides; However, the developer is currently in the process of compiling additional *M. Tuberculosis* datasets to build artificial intelligence systems through neural networks to produce accurate and accurate detection results of *M. Tuberculosis* with acceptable tolerances of 0.05 percent.

[Future study plan]

The system can be improved by making the Neural Network model train more datasets to make it more precise and making the system able to output the approximate amount of *M. Tuberculosis* in the slide and show each *M. Tuberculosis* coordinates on the spreadsheet.

[Keywords]

Artificial Intelligence, Mycobacterium tuberculosis, Acid Fast Bacilli, Neural Network Model, Datasets



The result image of an accuracy testing

CO-07

Developing application for predicting COVID-19 infection from chest X-ray images using deep learning techniques

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[Background]

The present COVID-19 epidemic has triggered an epidemic problem over the world, with several deaths as a result of the outbreak. According to research, when the virus enters the body, it connects to phemosite II allowing it to penetrate cells and release cytokines, resulting in an inflammatory response. Water enters the interstitial fluid, causing the ground glass to float, which can be seen on an X-ray of the lungs and lead to pneumonia, the leading cause of death. According to Singwiratham's research, there were more than 179 hospitals in Thailand lack of radiologists. In this study, deep neural networks called CNN architectures, will be used to create the predictive model for predicting the initial infection results. The final model will then be implemented into a mobile application.

[Purpose of the project]

Firstly is to study, analyze and develop a model for predicting COVID-19 infection from chest X-ray images using convolutional neural networks. Next is to measure and compare the model's effectiveness to find a suitable model for predicting COVID-19 infection. Lastly to develop an application for analyzing and predicting initial COVID-19 infections.

[Methodology]

In this study, chest X-ray data from researches of (Chowdhury et al., 2020) and (Rahman et al., 2021), has been applied for developing predictive model to predict the initial infection result of COVID-19. Firstly, the labeled chest x-ray images consisting of 3,616 and 10,192 images of COVID-19 patients and normal people, respectively. The quality of those x-ray images was optimized by converting into 4-dimensional arrays and RGB color format to meet the requirement by each type of model using the NumPy and OpenCV-Python libraries. Next step, 1,500 images were randomly selected from each class of chest X-ray images. To develop the predictive model, the data from last step has been randomly selected and divided into 2 groups 80% and 20% of training and testing set, respectively. Training dataset was used to develop predictive models by using 6 different type CNN, namely AlexNet, Xception, VGGNet16, VGGNet19, MobileNetV2 and NASNetMobile. The obtained models were assessed their predictive performance by calculating the error value using the Binary Cross-Entropy method. Confusion Matrix has been used to analyze the Accuracy, Sensitivity, Specification, F1 score, and ROC curve. Finally, the Gradcam algorithm was applied to represent the lung abnormalities discovered through the model analysis.

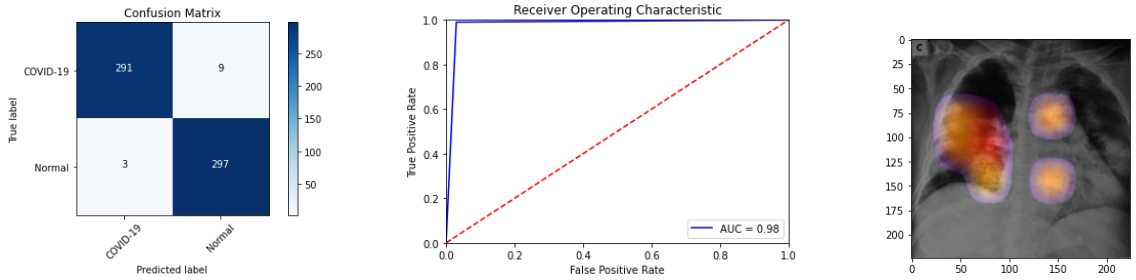
The best model obtained from the previous step was fine-tuned by varying the number of epochs to gain the most accuracy. Lastly, the best model was deployed to implement a COVID-19 chest x-ray images screening mobile application. The Flutter platform and Heroku cloud computing have been utilized to construct the mobile application.

[Results of the study]

Architecture	Accuracy	Precision	Recall	Specificity	F1-Score	Time per Epochs
AlexNet	0.80	0.91	0.75	0.89	0.83	29
Xception	0.82	0.94	0.76	0.92	0.84	30
VGGNet16	0.85	0.85	0.94	0.93	0.86	27
VGGNet19	0.81	0.9	0.76	0.88	0.82	30
MobileNetV2	0.98	0.97	0.99	0.97	0.98	25
NASNetMobile	0.79	0.95	0.72	0.93	0.82	34

Table 1 Result of model using balance data

Table 1 shows the result of model using balance data. MobileNetV2 show the best predictive performance. The confusion matrix, Receiver Operating Characteristics (ROC) Curve, and Gradcam algorithm of MobileNetV2 can be illustrated in Figure 1 (a)-(c), respectively.



(a) (b) (c)

Figure 1 Confusion matrix, ROC Curve and Gradcam algorithm of MobileNetV2

[Conclusion]

The CNN algorithms used are AlexNet, Xception, VGGNet 16, VGGNet 19, MobileNet V2, and NasNetMobile. The results represent that Models with balance data have better accuracy than imbalance data and the best algorithm, MobileNetV2, was able to predict X-ray images with 98% accuracy and was also able to determine abnormal locations in the lungs, the best.

[Future study plan]

Firstly, use a cloud with a faster graphics processor than Heroku Cloud, such as Google Cloud. Next is to increase the ability to differentiate other lung diseases such as pneumonia, leaky lung, lung cancer, etc.

[Keywords]
COVID-19, Chest X-rays, Convolutional Neural Network, Predictive model, Mobile application

CO-08

Making Thai script inclusive: universal Thai font

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[Background]
With the increased use of the Thai script, more importance is placed on the fonts used in documents, signage, and more. However, research into accessibility of Thai fonts has been lacking, and with the Thai society heading into an aged society, a formal research into the pitfalls and strengths of Thai font design can pave the way for a more accessible future for Thai language users.

[Purpose of the project]
To study the clarity of existing Thai fonts, namely its visibility, legibility, and readability, and to conclude on strategies for designing a clear and legible Thai font.

[Methodology]
Visibility and legibility of Thai script has been studied before, so readability is the only metric where manual data collection is required. An adapted version of the Chapman-Cook Speed of Reading test has been deployed, where participants have to read the text and spot errors while being timed. The test has been adapted to a Thai language version, and reproduced 10 times for 10 different fonts we chose to study. This gives us a metric to measure how fast each font can be read. The test is then randomized and printed and handed to participants of ages 18-65 from varying backgrounds, and data is then analyzed.

[Results of the study]
Initial findings show a trend where looped/serif fonts perform better than loopless/serif fonts; however, an analysis of variance shows no statistically significant difference with the current sample size.

[Conclusion]
Results are inconclusive as of the time of writing. Partipicipants are asked from well-educated groups that have a high reading skill which may have skewed the data. Data collection is still underway and is expected to complete by the end of the year.

[Future study plan]
The conclusion can be used to design a Thai font that meets the criterias required for a clearer font. Additionally, more research is needed to verify the methodology used in the other studies referenced, and the speed of reading test itself to ensure the accuracy of this study's findings.

[Keywords]
Human-computer interaction, fonts, speed of reading test, Thai script readability


KU

CO-09

Life jacket wearing detection system for safety water transportation using deep learning technology

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[Background]

The problem of fetal drowning can affect people of all ages. During the year 2012 - 2021 In Thailand, 35,915 people died from drowning. There was a controversial issue known in Thailand that was the case of *Tangmo Nida* or Pattida Patcharaweeraphong, a famous Thai celebrity who died in a drowning accident. She did not wear a life jacket during the ride (Khom Chad Luek, 2022), and wearing a life jacket at that time may help her survive. This is because life jackets are essential to keep people afloat, whether young or old. Wearing a life jacket reduces the risk of death from drowning; however, some people have neglected wearing lifejackets because of the inconvenience. We saw the importance of this problem. Therefore, we studied and developed a system for detecting people who are wearing life jackets for safety with deep learning technology to reduce the risk of death by drowning.

[Purpose of the project]

The aims of our study are finding the most efficient algorithm and training method for the object detection system to detect life jacket wearing and developing the system so that it can be used in real-time situations and locations.

[Methodology]

The researchers have studied and developed a system to detect wearing life jackets for safety from traveling on the water with deep learning technology that can distinguish people who do not wear life jackets and people who wear life jackets. Two methods were applied. The first method (2 classes) used the YOLOv5 model that was trained from the dataset of people wearing and without life jackets 348 photos. Method 2, HBJ algorithm, is a system that detects the wearing or not wearing a life jacket from detecting a life jacket overlapping the head or a person using a YOLOv5 model, which is trained from the head, body, and lifejacket dataset of 348 photos. We trained and validated model performances by 5-times cross-validation, dividing datasets into train, validation, and test datasets in an 8:1:1 ratio. To find the best model, we used the Accuracy, Precision, Recall, and F1-score averaged from 2 classes as the evaluation metrics. After we got the best model, we tested the model to count the number of people with 35 pictures.

To implement the model into a real problem, we built a web application using Flask as a web framework. Our web application is able to detect life jackets-wearing in real time via webcam.

[Results of the study]

From the 5-times cross-validation test, the Evaluation metrics averaged from 2 classes of the YOLOv5 model trained in 2 classes are 0.75 for accuracy, 0.80 for precision, 0.76 for recall, and 0.78 for F1-score. The Evaluation metrics averaged from 2 classes of the YOLOv5 model trained in the HBJ algorithm are 0.85 for accuracy, 0.87 for precision, 0.88 for recall, and 0.88 for F1-score.
From the people counting test, the model counted the number of people correctly in 24 pictures from 35 pictures which was calculated as 68.57% correctly.

[Conclusion]

Our system can solve the object detection problem of detecting either humans who are wearing or not wearing life jackets by using the HBJ Algorithm that was developed from YOLOv5 in this project. It gives the Accuracy, Precision, Recall, and F1-score averaged from 2 classes 0.85, 0.87, 0.88, and 0.88. It is also able to count people in the frame correctly at 68.57%. Only the YOLOv5 can be implemented into a web application to use in real situations in real time.

[Future study plan]

Our future plan is to develop the web application in order to implement the HBJ algorithm and be able to detect life jacket wearing via closed-circuit camera.

[Keywords]
Deep learning, Object detection, Life jacket

Figure 1. Web application

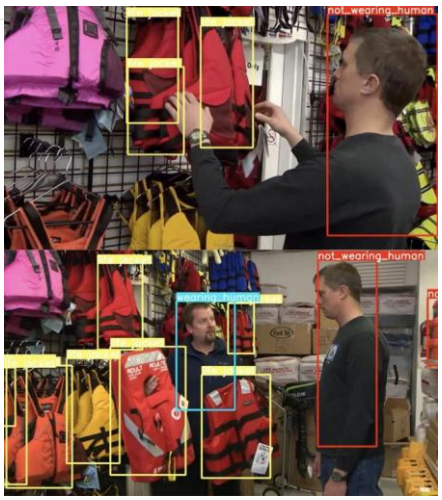

Figure 2. HBJ algorithm detection

CO-10

The extension of the assignment problem and its solution

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[Background]

The Assignment Problem is the problem of how to efficiently assign tasks to employees. In this problem, the number of each employee is responsible for and the number of employees responsible for each task are restricted. However, these restrictions are independent for each task and do not reflect the relationship among tasks.

[Purpose of the project]

To reflect the relationships among tasks, we consider the following restrictions for the ordinary Assignment Problem: For each employee, the number of tasks he/she is responsible for within a set of numbered consecutive tasks is restricted. Our purpose is to obtain a solution to this extended problem. We call this problem, “Interval Restricted Assignment Problem”. This can be applied in more practical situations.

[Methodology]

At first, we formulated the Interval Restricted Assignment Problem. Next, we gave the solution to the formulated problem. Finally, we implemented the solution method, performed experiments on a computer, and evaluated its performance by comparing it with the solution method using an integer programming solver. We denote the usefulness of the proposed method for this problem.

[Results of the study]

First, for the special case where the interval restrictions do not intersect, the problem can be solved quickly as a minimum-cost flow problem by putting the restrictions into a tree structure. Second, for the general case, some of the restrictions are Lagrangian relaxed to form a dual problem of the minimum-cost flow problem, which can be solved quickly, especially for the small cost case.

[Conclusion]

We discuss the usefulness of the method for solving the Interval Restricted Assignment Problem, which is incorporated the relationship between tasks into the restrictions. For the special case where the interval restrictions do not intersect, the problem is solved fast enough. On the other hand, the general case is affected by the fact that the search range exponentially widens with respect to the cost value. Since it is natural for the relationship between tasks to be a tree structure, this can be applied in many situations where one employee is responsible for multiple tasks.

[Future study plan]

We consider algorithms that can operate at high speeds even with large cost values in general case.

[Keywords]
Minimum-cost flow, Assignment problem, Lagrangian relaxation method, Optimization, Algorithm

CO-11

The high-voltage tower climbing robot

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[Background]

At present, China's power transmission lines have been under continuous construction, and the number of high-voltage pylons is increasing and the distribution is becoming more and more widespread. The operation of the transmission line will directly affect people's life and work, so the maintenance of the power tower is particularly important.

[Purpose of the project]

Manual inspection, the risk of electric shock is high, the work efficiency is low. I would like to design a robot to replace manual climbing of the power tower and implement simple operations, which will greatly reduce the labor intensity of maintenance personnel and improve the safety of maintenance operations.

[Methodology]

In the process of project research and development, I learned Solidworks 3D drawing software, 3D printing technology, single-chip technology, the production of mobile phone APP, basic circuit theory and basic knowledge of mechanical manufacturing by myself.

[Results of the study]

The high-voltage tower climbing robot is developed based on the form of a four segment mechanical arm. It is composed of six parts, including 5 joints and 2 claw clips, with a length of 70cm and a mass of 600g. The robot is 3D-printed with PLA material. The robot uses a mechanical claw clamp to grasp the leading steel on the four sides of the high-voltage wire tower, and fixed by way of self-locking. It climbs forward in a big rolling way. It can move autonomously and controllably on the leading steel frame of the high-voltage wire tower. The robot is equipped with camera equipment, which can be controlled by tablet computer and mobile phone. This robot can also grab the rubbish on the wire tower for simple maintenance.

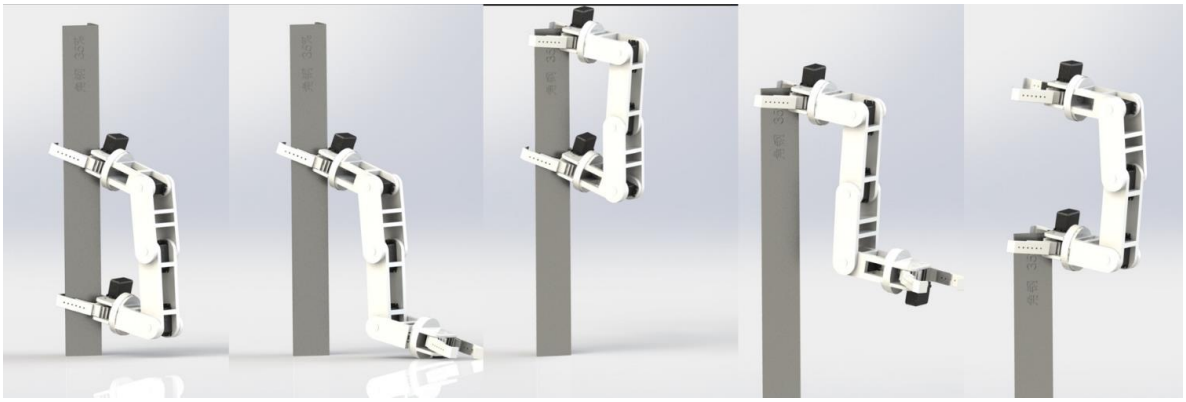
[Conclusion]

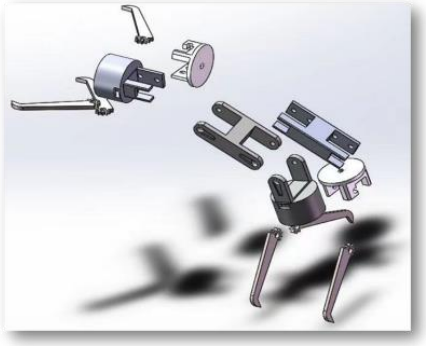
In this study, a new monitoring and maintenance robot that can climb along the four sides of the high-voltage power tower is protagonist. A completely new control system was also created. Compared with the existing high-voltage wire tower climbing robots, this scheme has a simpler structure, can adapt to different types of angle steel frames, and has strong usability.

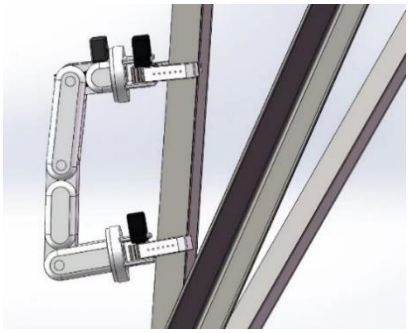
[Future study plan]

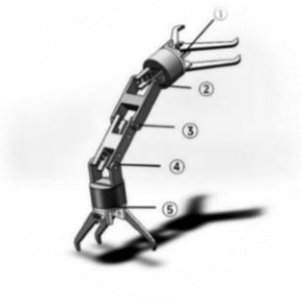
In the future, I will continue to improve the robot and expand its functional modules, such as electric bolt tightening and welding modules, to improve the practicability, versatility and reliability of the robot.

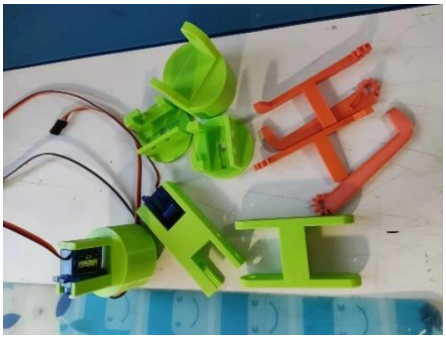
[Keywords]
Wire towers, Climbing robot, Robotic arm, Self-locking, Claw clamp











CO-12

iSupskin, artificial intelligence program for CNN-image classify

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[Background]

Currently, Thailand tends to suffer from skin diseases such as eczema, tinea, inflamed skin and psoriasis. Which has increasing statistics (Institute of Dermatology, Ministry of Public Health, 2019). Causing doctors to work hard because there are many patients. Developers can realize the application of artificial intelligence. The program can analysis a large amount of data in a very short time, people can use it to detect skin diseases. Eczema, inflammation, and psoriasis, so people can get a thorough examination, not delay and reduce the work of medical personnel. Therefore, we combine artificial intelligence and skin disease problem for people that we called iSupskin.

[Purpose of the project]

1. To study the operation of artificial intelligence system in the machine learning process using Algorithm CNN-Image classify and developed with Python.
2. To develop iSupskin, an artificial intelligence program analyzing basic skin diseases with CNN-Image classify.
3. To test the efficiency in analyzing images of iSupskin, an artificial intelligence program for analyzing basic skin diseases with CNN-Image classify.
4. To study on user satisfaction of iSupskin program, an artificial intelligence program that analyzes basic skin diseases using CNN-Image classify.

[Methodology]

1. Study and research the preliminary dermatology analysis program.
2. Create a picture case for creating a model of program. (500 pictures in each case images)
3. Plan and design program development.
4. Develop the program according to the plan.
5. Test the performance of the program.
6. Improve and complete the program.

[Results of the study]

The results of the iSupskin efficacy test were able to detect primary skin diseases, including normal skin, eczema, tinea, inflammatory skin disease, and psoriasis. The analysis accuracy was 84%, the analysis error was 16%, and the user satisfaction rating was 4, which was very satisfactory.

[Conclusion]

iSupskin, an artificial intelligence program, analyzes basic skin diseases with CNN-Image classify, has tested the effectiveness of the iSupskin program to detect basic skin diseases. These include eczema, ringworm, tinea versicolor, psoriasis and normal skin. The analysis accuracy was 84%, the analysis error was 16%, and the user satisfaction rating was 4, which was at a very satisfied level.

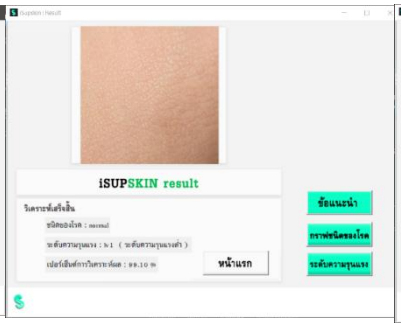
[Future study plan]

1. Develop a program to cover more skin diseases by increasing the type of skin disease.
2. Develop artificial intelligence systems for more accurate and faster processing.
3. Develop the program to be able to work on smartphones to increase the convenience of taking

pictures, adding images to the program and can analyze the skin condition at any time.

[Keywords]
Artificial Intelligence, Python, CNN-Image classify

Picture 1: GUI 1



Picture 2: GUI 2

Picture 3: GUI 3

CO-13

AI-based hazardous materials sign detection for rapidly manufacturer rescue robot

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[Background]

Factory and laboratory explosions are serious accidents that have a negative impact on human life and properties. Rescue operation is a difficult task because rescuers must be aware of unexpected incidents or dangers, such as leaks of hazardous materials and explosions of flammable substances. Therefore, pre-rescue exploration is very important. Nowadays, innovations such as rescue robots have played a great role in helping humans in such tasks. The advantage of using robots is a camera that can read and classify hazard symbols using Artificial Intelligence (A.I.), which is faster and more accurate than human vision. Also, A.I. has become important in human society in many ways, whether it is real-time data evaluation and analysis or its ability to learn and improve by themselves.

[Purpose of the project]

The purpose of this project is to develop a real-time AI camera system using computer vision to detect hazard symbols in the scene of an accident. Combined with a pre-trained model for human detection, the system will notify the rescuer to plan and prepare the rescue operation in advance.

[Methodology]

In this project, the Convolutional Neural Networks (CNN), which is similar to the Artificial Neural Networks (ANN) model but has extra convolution layers, was used, along with, YOLOv5 (You Only Look Once version 5), a state-of-the-art object detection model, as a supervised learning.

To create the dataset, images taken by the RGB camera on the prototype robot and obtained from the Internet, totaling 10,184 images, were labeled, and data augmentation was performed to mimic real-life situations. Then, the data were randomly assigned to 3 sets: train set, valid set, and test set. When finished, the dataset was exported to YOLO v5 PyTorch format.

After data preprocessing, the training process begins with a train set, following a valid set to measure performance for each epoch, and a test set to evaluate the precision rate, recall rate, and F1-score of the model. These data serve to check the accuracy of the system.

In the actual setting, the image from the robot camera was sent via local network and passed to our trained model. The classification result, formatted as Pandas dataframe, was then plotted on image, which were saved as a file for further review.

Precision rate:

$$\frac{\sum True\ Positives}{\sum(True\ Positives + False\ Positives)}$$

Recall rate:

$$\frac{\sum True\ Positives}{\sum(True\ Positives + False\ Negative)}$$

F1-score:

$$2 \times \frac{Precision \times Recall}{Precision + Recall}$$

[Results of the study]

The result of the experiment showed that the precision rate was 92.9%, recall rate was 96.4%, and F1-score was 94.8%, which means our model can detect at high accuracy. However, this system still had few errors when detecting faded hazardous material signs.

[Conclusion]

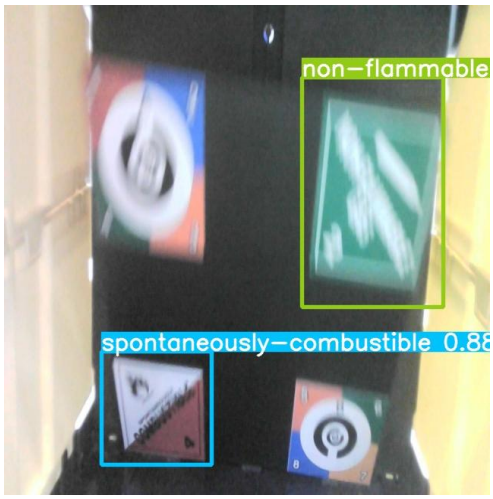
The real-time AI camera system using computer vision was successfully developed with high detection accuracy. However, it still cannot detect symbols that are heavily damaged, such as dimmed color or a certain amount of covered dust.

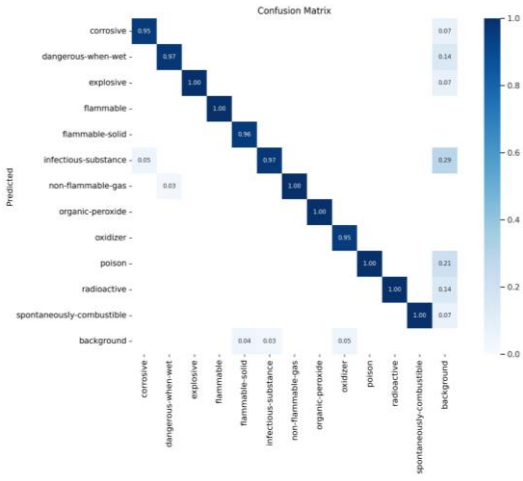
[Future study plan]

In the future, more training will be done until our AI system can detect the dimmed or covered-with-dust symbols. Moreover, a system for identifying dangerous objects and creating a rough survey area map in 3D will be developed. With these features, people who go to the rescue can plan operations much more efficiently.

[Keywords]

Hazardous materials, Hazmat sign detection, Sign recognition, CNN, Rescue robot, RoboCup, Rapidly manufacturer rescue robot





Social Science & Liberal Arts

LA-01

Thai traditional music composition using long short-term memory network

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[Background]

Artificial Intelligence, or AI, in the music industry plays a role in developing music over the years. AI has been used to compose many popular songs, such as *Daddy's Car* by Sony CSL, with almost 3 million views on YouTube. However, there has not been much application of artificial intelligence on Thai traditional music.

The popularity of traditional Thai music has been declining due to many reasons and factors. One of the reasons is the lack of novelty in the genre and style. Without adapting to modern society and technology, it would be difficult to preserve Thai traditional music.

We recognize the importance of this issue, and we propose a solution that involves using artificial intelligence to generate traditional Thai music in order to create novelty in composition that can help Thai traditional music advance so that it can survive the current era of change.

[Purpose of the project]

To study methods and results of using artificial intelligence to compose Thai traditional songs. To compose new Thai traditional pieces that are interesting and have more varieties by using artificial intelligence.

[Methodology]

We are proposing the use of Long Short-Term Memory (LSTM), a type of neural network useful for generating sequence data, to generate Thai traditional music. To do this, we recorded and gathered MIDI samples of 60 total Thai traditional pieces including three different types of rhythm: 20 Sam-Chan (slow paced) pieces, 20 Song-Chan (medium paced) pieces and 20 Chan-Diew (fast paced) pieces. The samples were represented in text form using the standard abc-notation. The AI base model learned the underlying style from given samples. We then used the model to generate the next notes one by one and allowed new combinations of notes to be made. Outcome assessment was made using blind tests with people of various musical backgrounds. This was done by pairing the generated songs with original songs, and asking the evaluator to guess the one composed using AI after presenting them with some examples.

[Results of the study]

Preliminary results show that the model can generate reasonable sounds with creativity within major characteristics of the Thai traditional genre. We observed that hyperparameter tuning was significant to the final results. Batch size, numbers of RNN units, and epochs all affected the lengths and novelty of the generated songs. We used fuzzy string matching score to represent the novelty factor. The generated texts had an average score of 70.2%, with the average song length of 2 minutes and 34 seconds. We are in the process of making blind tests. According to previous studies, our AI should be able to create a variety of melodic elements in the style of Thai traditional music. Despite some generated pieces not being realistic and complete without human composers' help, they still can inspire composers to make new, interesting Thai traditional pieces.

[Conclusion]

By using AI to generate new Thai traditional music based on the existing pieces, using the LSTM based model, we completed the two purposes of our project. We have studied the methods and

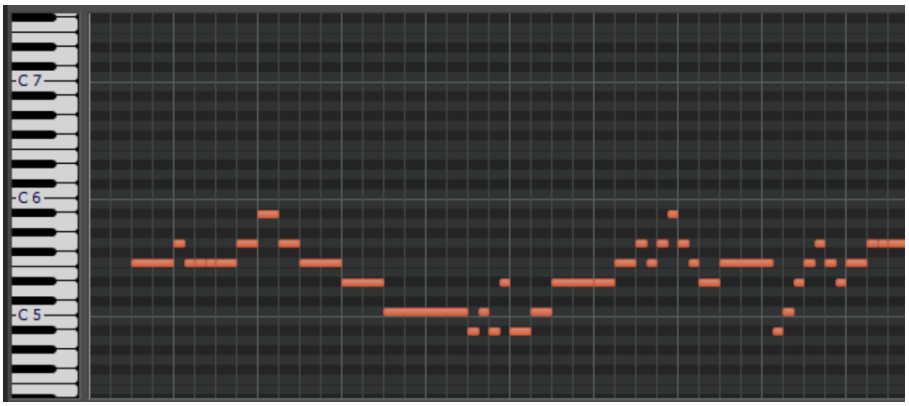
results of using AI to generate Thai music, and also have generated original Thai pieces.

[Future study plan]

We currently have three goals.

- To tune and optimize the hyperparameters and find their effect on the generated songs.
- To record and collect more Thai traditional music data to increase the size and variations of our database.
- To perform more blind tests with the generated songs and with real users.

[Keywords]
LSTM, Thai traditional music, Abc-notation, Midi



Picture 1: A recorded midi file of Kham Wan displayed on the piano roll during the recording process using CakeWalk, a digital audio workstation.

Figure 1: Training loss per training iterations (trained using 120 RNN units, 8 batch size, and 1000 epochs)

LA-02

Examining the effect of AI on social conformity between adolescents

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[Background]

Although research has been done with adult human participants (aged 18 and above) to study the effect of introducing artificial intelligence (AI) to a group environment on the group's tendencies to conform, we believe it is also crucial to conduct such studies with younger participants, specifically adolescents between the ages of 12 to 16 in order to attain a more profound understanding of the relationship between AI and human conformity

[Purpose of the project]

Our purpose of the project is to understand the relationship between AI and human conformity regarding adolescents, such that we can be more cautious about the effects regarding AI on our behavior.

[Methodology]

Our experimentation was conducted virtually, where participants answered general trivia and simple mathematics questions in two different 'sets'. 'Set 1' had 1 participant, researchers posing as 3 other participants, 1 host and 1 'robot', while 'Set 2' had the exact same configuration except with the 'robot' being replaced by a human counterpart. We then compared the percentage of times that participants changed their responses after being made aware of other participants' responses in *Robot-Humans* ('Set 1'), with that of *Human-Humans* ('Set 2').

[Results of the study]

We found that participants had a higher percentage of conforming when a robot was present (50%), in comparison to when replaced with another participant (36.7%). Most participants also conformed due to uncertainty. We were successful in proving our hypothesis that the human participants were more likely to change their answers to conform to information shared in the group with a robot as compared to information shared in the group with a human counterpart.

[Conclusion]

Hence, our project is able to provide a guiding step to future research on fostering constructive and beneficial connections between AI and humans

[Future study plan]

We plan to find more human participants of different ages, in order to see if adolescents are indeed the ones affected most by AI regarding conformity.

[Keywords]
Conformity, Adolescents, AI

LA-03

A comparative study of three forms of learning media (videos, short articles, and infographics) on their effectiveness in helping high school students to 'rethink'

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[Background]

Nowadays, communicating and receiving new information can be done quickly and easily, so people receive a lot of data every day. Of all the information that we obtain, some of it may be false. A theory that has been correct up until now may be challenged by new evidence. Therefore, one of the most important skills in this era is rethinking. It can help people analyze and compare the rationality of new knowledge with existing beliefs. Moreover, in the educational arena, in order to succeed in teaching, teachers may use media to demonstrate the lessons and make them easier to understand. Consequently, we decided to study the differences between three popular forms of learning media, which are videos, short articles, and infographics, in terms of their ability to make high school students rethink.

[Purpose of the project]

The purpose of the project is to compare three forms of learning media (videos, short articles, and infographics) that help high school students to rethink.

[Methodology]

Firstly, we looked for 30 participants. Once we got 30 participants, we asked them do a pre-test to collect the data on what they believed in three different topics. In the first topic of political changes, the question asked whether peace or violence had higher chance of success in making political changes. For the second topic, which was about benefits of books and e-books, we asked which had more benefits for readers. In the last topic of the appropriateness of capital punishment, we asked them whether death penalty should be used or not.

Secondly, we gave them the opposite viewpoints in each topic in the forms of different media (videos, short articles, and infographics). The videos would present information on the topic of political changes, which could be separated into two ways, one where peace led to a successful political change, and the other where violence led to a successful political change. As for short articles, they were used to present information on the topic of benefits of books and e-books. This was also separated into two ways; one saying that book has more benefits, and the other with e-books having more benefits. The last form of media, infographics, presents the information on the topic of appropriateness of capital punishment, and there were two different infographics; one supporting the idea that capital punishment should be applied at the present time, and another arguing against it. Consequently, we would have six different media in total: two videos, two short articles, and two infographics. For example, if the participant submitted the questionnaire as follow: I believe that peace can lead to success in political changes, that an e-book has benefits more than a book, and that there should not be death penalty. When it was time for the learning process, we would give the participant a video saying that violence could lead to a success in political changes. Then we would give a short article that explained the benefits of regular books over e-books, and an infographic stating that death penalty should be used.

Once each participant had finished studying the opposite viewpoints from the three forms of media, we asked them do a post-test to identify whether the rethinking process had taken place or not, and also looked for relevant factors that contributed to it. With the post-test result, we would

know whether individual participants had changed their thought or not. We would also learn why they changed or did not change their thought, and what factors were encouraging rethinking, such as content message, credibility effect, and types of media. Finally, we analyzed and drew a conclusion.

[Results of the study]

The findings indicate that the numbers of people who had changed their answers in each media type from the highest to the lowest is as follows: 20 people for short articles, 12 people for videos, and 10 people for infographics. Cited by 18 people, we found that content in media was the most effective factor that had an effect on rethinking. From the participants' opinions, only seven people thought that the type of media had the strongest effect and five people believed that media credibility had the most effect on them. Due to the large difference in results, we decided to collect more data on how much had the type of media and credibility affected the people who rethought. We used correlation coefficients to measure the relationship between rethinking and the two factors, type of media and credibility. The result shows that the correlation coefficient between rethinking and both types of media and credibility in each media was low or very low.

[Conclusion]

Types of media and credibility were not the main factors that contributed to rethinking, but media content was the most effective factor in this. Nevertheless, although types of media did not have much effect, if we look into the type of media that had the most effect on rethinking, it was short articles, followed by videos and infographics respectively.

[Future study plan]

We can change the field of study from high school students to another age range. For example, we may adjust the age range from 17 years old student to 30-40 years old.

[Keywords]
Rethink, Type of media, Content, Credibility

LA-04

Conformity between human and artificial intelligence the effect of AI on human decision-making to the effect of humans on human decision-making in teenagers aged between 15 - 17 years old

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[Background]

Artificial Intelligence (AI) plays an important role in our daily lives including traveling, shopping, working, and studying for all generations.

The Authors believe that studies in this area should be studied at various ages; especially in the group of teenagers including the advantages and disadvantages of AI for this group of people.

[Purpose of the project]

To compare the effect of AI on human decision-making to the effect of humans on human decision-making in people aged between 15 - 17 years old.

[Methodology]

We select our subjects by random sampling method and observe their decision by dividing them into 2 groups; each group consisting of 20 people. Then, they will be answering the same sets of questions and having a pursuer (one being AI and the other being human). The pursuer will lead our subjects to answer the same answer in each question.

We start by collecting data from the control group using 20 questions on Google form which have already been qualified by the IRB. The question will give a picture of a pair of eyes, then it asks the participant to select 1 of 4 given choices that match the emotion of the eyes best. After we got an answer from the control group, we sort each question into 4 groups depending on the answer pattern that the control group gives. The questions that are selected to be used will be in such a way that the most answered option is not more than twice the number 2 answer, and the sum of the 1st and 2nd most answered option is greater than 75% of the total answers. The information in this section will be used for further analysis.

[Results of the study]

In the first method, overall subject conformity was analyzed, ignoring the type of answers. We analyzed it using the following equation

$$\sum_{i=1}^{10} \frac{y_i - x_i}{x_i}$$

We'll get the value of the human-influenced group of -0.063, while the AI-influenced group has a value of 0.358, indicating that the AI has a higher persuasion ability than the human.

In the second method, the percentage of people who responded to the motivation question was analyzed by considering the total number of people in each question. The results showed that the average of the general opinion was 44.4%, the average of the people influenced was 39.5%, while the standard of the group that was influenced by AI was 59%, which showed that AI has a higher persuasion ability than humans.

In the last method, averaging the number of questions answered by people who were influenced by dividing them into 2 groups, the result was that the human persuasion of the questions in which the answers were in the first largest group was 1.85 questions, while the AI-influenced group in

which the answer was in the 1st largest group was 3.5 questions, and in the human-induced group. Among the questions in which the answers were in the 2nd largest group was 2.1 questions, while in the group that was influenced by AI, the questions in which the answers were in the 1st largest group were 2.85 questions, indicating that AI has the ability to influence more than human.

Of the three methods, they all pointed in the same direction in such a way that human-AI reconciliation occurred higher than human-to-human reconciliation.

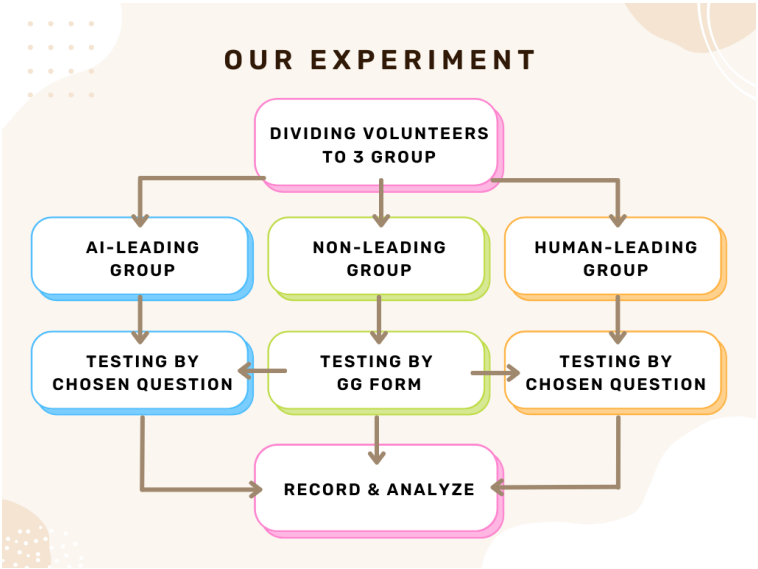
[Conclusion]

From our study, humans have more tendency to change their answers when they are convinced by AI than by humans themselves.

[Future study plan]

Our future study plan is to study in a bigger and more varied group. Besides, we would like to change our analysis method to be more universal.

[Keywords]
Conformity, Artificial intelligence, Human decision



LA-05

Derivation of a concrete learn unlearn relearn framework by using cooking as a case study

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[Background]

As times change, humans are faced with predicaments where they have to adapt to new things – learning foreign concepts, unlearning and relearning pre-existing mindsets, beliefs, and knowledge where necessary. An essential Learn Unlearn Relearn (LUR) Model has been observed, yet this concept is still foreign to many as there is no proper definition to this model.

[Purpose of the project]

Hence, this paper will explore if it is possible to facilitate this new model of learning.

[Methodology]

Cooking, a tangible, active skill was analysed to create a step-by-step framework. A comprehensive questionnaire was sent out by online means to participants of various ages and backgrounds with different mastery levels in cooking. Upon analysis of the learning process of respondents equipped with this learnt skill, we marked out points where learning, unlearning and relearning took place, also paying attention to respondents that took a short time in skill acquisition.

[Results of the study]

It is also observed that contrary to popular belief, having an expert in your subject field may not be the most ideal way of learning as it could create a culture of dependency.

[Conclusion]

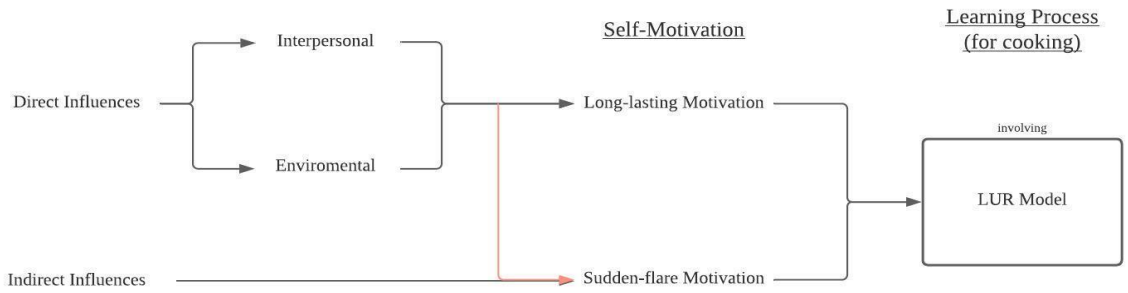
With the supplementation of other research like existing learning models and the findings of other papers, a concrete step process was created, consisting of, Preparation, Contemplation, Application, “Surprise Factor”, Realisation, Revision and Repetition.

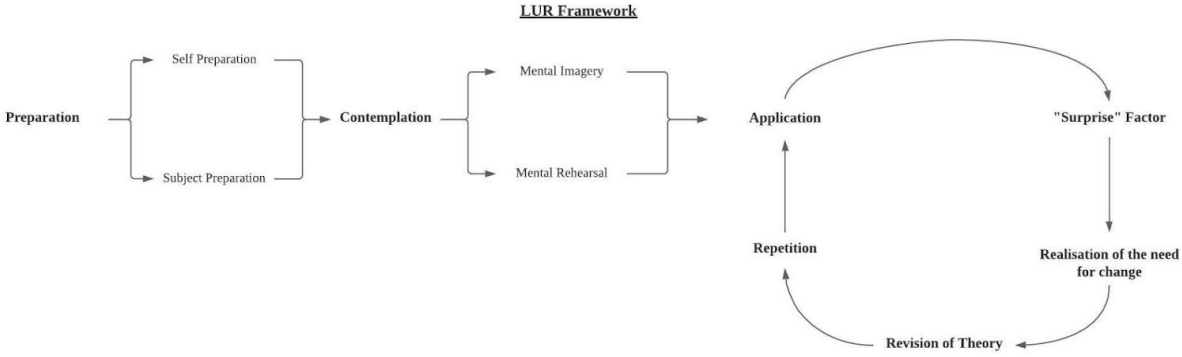
[Future study plan]

If further explored, the ease of comprehension, universality and effectiveness can be tested and then applied to societal contexts. Learning would then be able to be made more efficient for mankind.

[Keywords]

Learn, Unlearn, Relearn, LUR Framework, LUR Model, Cooking, Motivations, Thought Chain


Direct Influences
Interpersonal
Enviromental
Indirect Influences
Self-Motivation
Long-lasting Motivation
Sudden-flare Motivation
Learning Process
(for cooking)
involving
LUR Model


LUR Framework
Preparation
Self Preparation
Subject Preparation
Contemplation
Mental Imagery
Mental Rehearsal
Application
"Surprise" Factor
Realisation of the need for change
Revision of Theory
Repetition

LA-06

3D model of water pollution

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[Purpose of the project]

Water is the most important and basic element to sustain life on Earth. Earth comprises about 70% of water, where humans and animals consume only 1% of fresh and healthy water for daily activities. Since 1950, the human population has rapidly increased continuously till now which leads to gaining usage of basic needs such as food, water, air and shelter. As the usage increases by humans, pollution has also gone to another level which leads to water pollution, air pollution and soil pollution. Natural disasters specifically volcano eruption, flood, hurricane, tsunami are also taking a big part of polluting the Earth. Among those pollutions, water pollution has concerned me by how small the amount of water that we are using and how we are still continuously contaminating the water. Which are the reasons I would like to create the 3D model of water pollution to make our planet a better place with less environmental issues.

[Methodology]

To disseminate effectively about the project, forming an example of a city with water pollution that includes causes and effects into a 3D model or a smaller design makes it much easier to learn and understand. The model was assembled by handmade miniature factory, houses, garbage truck, trash, bridge and stream.

[Results of the study]

3D model of water pollution have been designed for better understanding of the causes, effects and solutions of water pollution that are causing environmental damage. I'm looking forward to disseminate about water pollution to make a sustainable living and attach oneself to come to an end of water pollution.

[Conclusion]

I can conclude that modeling this model will make us understand better and to take part in conservation that will make our planet into a better place. This model will introduce the causes, effects and solutions for a sustainable planet.

Mathematics

MA-01

A natural extention of 3D catalan numbers

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[Background]

One of the method to define Catalan numbers is to use Dyck path which is a stair case walk from (i,j) to (i',j') that lies strictly below (but may touch) the diagonal y=x. Also, there is the research of the generating function about the number of Dyck paths that meet y=x n times. We wanted to extend it to 3D, so we tried to make generating function of 3D Catalan numbers, but it is too complicating.

[Purpose of the project]

The significant of our research is an extention of existing research. To express the number of Dyck path from $(\mathrm{i},\mathrm{j},\mathrm{k})$ to $(\mathrm{i}',\mathrm{j}',\mathrm{k}')$that meets plane x=y n times as a linear combination of the numbers of common Dyck path.

[Methodology]

$\boldsymbol{D}\big((\mathbf{i},\mathbf{j},\mathbf{k}),(\mathbf{i}',\mathbf{j}',\mathbf{k}')\big)$ = number of path from $(\mathrm{i},\mathrm{j},\mathrm{k})$ to $(\mathrm{i}',\mathrm{j}',\mathrm{k}')$
$\boldsymbol{D_n}\big((\mathbf{i},\mathbf{j},\mathbf{k}),\ (\mathbf{i}',\mathbf{j}',\mathbf{k}')\big)$= number of Dyck path s from $(\mathrm{i},\mathrm{j},\mathrm{k})$ to $(\mathrm{i}',\mathrm{j}',\mathrm{k}')$ that meets plane x=y n times

To compare D and D_n, and to prove the relationship of them, we use some bijections between common Dyck paths and Dyck paths that meet x=y n times, and show equality the size of the set of paths.

[Results of the study]

$$D_0\big((i,j,k),(i',j',k')\big) = D((i+1,j,k),(i'+1,j',k')$$

$$D_1\big((i,j,k),(i',j',k')\big) = D((i+1,j,k),(i',j',k') - D((i+2,j,k),(i'+1,j',k')\ (i \neq j)$$

$$D_2\big((i,j,k),(i',j',k')\big) = D((i,j,k),(i',j'-1,k'-1) - D((i+1,j,k),(i'+1,j'-1,k'-1))$$
$$+D((i+1,j,k),(i'-1,j',k') - D((i+2,j,k),(i',j',k'))$$
$$= D_1((i-1,j,k),(i',j'-1,k'-1) + D_1((i,j,k),(i'-1,j',k')\ (i' \neq j')$$

$$D_n((i,j,k),(i',j',k')$$
$$= \sum_{i\le x\le i'} \sum_{k\le y\le k'} D_0((i,j,k),(x-1,x,y)) \left\{\sum_{z=0}^{n-1} D_z\big((x,x+1,y+n-1-z),(i',j',k')\big)\right\}$$

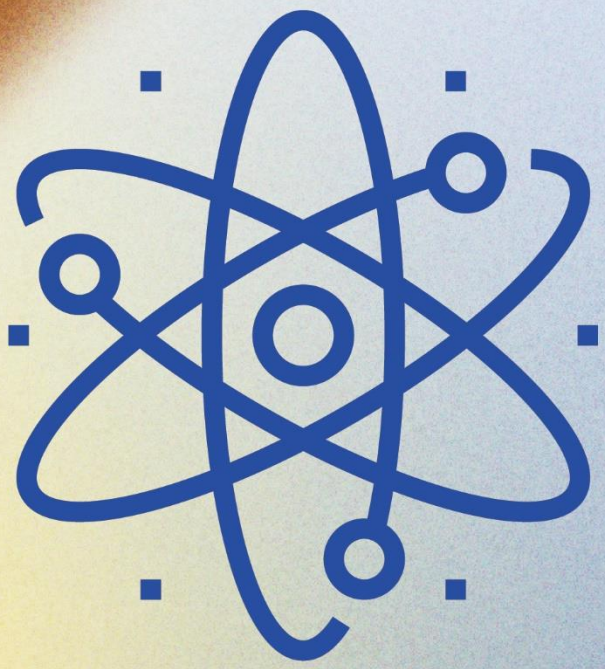
[Conclusion]

We can express D_n when n=0,1,2 and all natural number of n.

[Future study plan]

For all natural numbers n, we will find the simple expression of D_n. Also, we will formulate the generating function of D_n like existing research.

[Keywords]
3D Dyck path, 3D Catalan numbers, Bijections between paths



Physics & Astronomy

PH-01

A Bicycle that minimizes counter-steering

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[Background]

Counter-steering is a phenomenon deeply related to bicycles staying upright on their own. Just like the way it leans in the opposite direction the front wheel initially turns, a moving bicycle leans in the direction canceling its previous disorientation. The forces that keep bicycles up, the same ones that cause counter-steering are: centrifugal force from the wheels, castor trail effect, and torque due to weight distribution.

[Purpose of the project]

The main purpose of this project was pure curiousness. After learning about counter-steering on the internet, a sudden curiosity arose that whether a bicycle model without counter-steering happening would be possible. Eventually, using the results of this study, a bicycle without counter-steering mechanism could be made. It could be used to effectively reduce the difficulty of learning how to ride a bike and the action of changing direction on a single-track vehicle.

[Methodology]

We developed a new model including a new angle variable gamma. This model consists of three modified differential equations. We plugged in actual values for the variables in the odes and solved the equation using the NDsolver of Wolfram Mathematica.

[Results of the study]

For the equations representing a bike with no rider, all the angle variables exhibited weakly damped oscillating graphs and eventually returned to equilibrium. This shows that the new model can stabilize bicycles more efficiently.

For the case in which there is a rider, we include a term concerning the torque between the rider and the bicycle. If we solve the new set of equations, the graph of steering torque shows that no counter-steering is required for our model.

[Conclusion]

We could theoretically prove the stability of bicycles without counter-steering by equating various torques to the angle variables and numerically solving the odes. We could also, see that this model would improve the stability of riding, as can be seen with the gradually decreasing, oscillating graphs of a few variables.

[Future study plan]

If we could apply our model to aviation vehicles, it would hugely benefit the safety of airplanes. For aviation vehicles, which obviously have no interaction with the ground, terms that represent the interaction with the ground should not be considered. This gives us other equations about aviation vehicles changing direction.

[Keywords]
Bicycle, Stability, Counter-Steering, Lean Torque, Conservation of Angular Momentum

PH-02

The study of the correlation between shade with the surface tension and buoyant force of water strider' movement on the water surface

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[Background]

Water striders are remarkable non-wetting legs that enable them to stand effortless and move quickly on the water due to the surface tension force (Xuefeng Gao & Lei Jiang, 2004). However, we can't be sure that there is the buoyant force which helps water striders be able to move on water

Project organizers are interested in the surface tension and buoyant for measurement from the leg's shadow which occur on the water surface. This study will help us to understand the surface tension theory and the buoyant force theory, which may lead us to develop a new innovation relating to both theories.

[Purpose of the project]

1. The correlation between shadow width and length with surface tension force and buoyant force from legs' shadow in Z-axis
2. The correlation between water strider's mass with surface tension force and buoyant force from legs' shadow in Z-axis
3. The correlation of surface tension force of legs' shadow at 0.1 second of all legs

[Methodology]

1. Determining a location area and collecting the representative group of water striders
   1.1 We collected the representative group of water striders from pond in front of school
2. Experiment and data collection
   2.1 Ten water striders which have same size were collected and were numbered from 1 to 10.
   2.2 The water striders' legs shadow on the water surface was observed by using the point light above water surface and what happened was recorded in Z-axis on the video in a 25℃ room with the light turning off.
   2.3 Each water strider was weighed on a digital scale.
   2.4 The 70 percent of alcohol concentration was used for euthanasia of water strider.
   2.5 The water strider's legs were compared with a ruler using a stereoscopic microscope.
3. Data analysis
   3.1 The water striders' legs touching water, as well as the shadow width and shadow length were measured by Tracker program; then, they were compared with the former scales.
   3.2 The data collected were calculated for a surface tension force by $F = \gamma \times 2l$
   When F is the force per unit length (N)
   γ is surface tension (N/m)
   l is the length of the acting force (m)
   *assign the value of surface tension (γ) of water (H2O) in 25℃ is 0.072 N/m
   3.3 The perimeters of the area of the shadow were measured by Tracker program.
   3.4 The GeoGebra program was used to identify the area of the shadows.
   3.5 The data gotten were calculated for a buoyant force by $F_n = \rho g B$

   When F_n is buoyant force (N)
   ρ is density of water (kg/m^3)
   g is the acceleration due to gravity on Earth (9.78 m/s^2)
   B is shadow area (m^2)

*assign the value of density (ρ) of water in 25°C is 10^3 kg/m^2

3.6 For the 3rd purpose, the perimeter of shadows were measured by Tracker program and the surface tension force was calculated by $F = \gamma \times l$

[Results of the study]

1. The correlation between shadow width and length with surface tension force and buoyant force from legs' shadow in Z-axis showed that the shadow width and length were directly variable to the surface tension force; the leg length increased the shadow length which also affected the increase of surface tension force according to the equation, F = $\gamma 2l$. shadow width and length were directly variable to the buoyant force due to increased shadow width and length affected the increase of area B according to the equation, $F_n = \rho g B$.
2. The correlation between water strider's mass with surface tension force and buoyant force from legs' shadow in Z-axis found that that the water striders' mass was directly variable to surface tension force and buoyant force. When water striders' mass increased, it affected the pressure depth of legs so that affected increase of the shadow area and F = mg when water striders' mass increased it affected the shadow width and length increased so that the water surface; according to the equation, F = $\gamma 2l$ and buoyant force; according to the equation, $F_n = \rho g B$. As the mass pushed against the body weight to prevent water surface disintegrating, which correlated to Equilibrium theory. Related to *Yelong Zheng* and team research found that the increased of shadow width and depth, It's affected the increase of buoyant force.
3. The correlation of surface tension force of legs' shadow at 0.1 second of all legs found that all legs have different of surface tension force according to the equation, F = γl due to the changing of leg behavior. If one of each leg raise up, another has to receive all of weight to balance their body so it affected to size of shadow area and related to *Yelong Zheng* and team research found that, force that affected to each leg are different

[Conclusion]

1. Study about movement behavior and Morphology especially about tiny hairs (microsetae) and secreted wax.
2. Study about Movement factors, jumping and force that effect to jumping and movement.
3. Related information with SDGs no.14 (Life Below Water) to make innovation that can track acidity in ocean water

[Future study plan]

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[Keywords]

Surface tension force, buoyant force, Water strider

PH-03

How can muscle signals be used to control other devices?

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[Background]

The goal is to design a machine that interfaces with living neurons that control a device or for sensory substitution. For example, for someone having an issue with their spinal nerves, the muscles themselves can be stimulated by Functional Electrical Stimulation, which helps to move. Similarly, a person having an artificial limb, such as a robotic arm, can use the electrical activity generated by the EMG in their pectoral muscles to control the motors and control systems in the robot.

[Purpose of the project]

The purpose of this project is to investigate muscle signals to control other devices, in this case, a Transcutaneous Electrical Nerve Stimulator (TENS) to excite and contract the muscle of another human. After succession, implementation of an intricate robotic arm which can be controlled using thought from the brain, the new generation of prosthetic limbs.

[Methodology]

PART 1:

1. Two EMG electrodes placed on the elbow which is directly above the ulnar nerve, and connected to the TENS machine and the TENs header pins connected to the muscle spikershield
2. EMG electrodes placed on the forearm and one on the back of the hand, and the wires which will contain electrical impulses, connected to the muscle spikershield.
3. After completion of Step 1 and 2, connect the 9V battery which will function as a power supply to generate electricity for the experiment.
4. Controller and controlled connected to the spiker shield, and battery acting as the power source while the TENS machine pulse rate setting gets adjusted to settings 20 Hz,40 Hz, 50 Hz, 70 Hz, 80 Hz.

PART 2:

1. Servo Motors placed on the robotic arm
2. Servo motor ground, signal and voltage wires connected respectively to Arduino nano and adafruit to send and receive electrical impulses conducted by the motors
3. Power wires connected to muscle spiker as well as TENs machines headpins

Pulse rate set to most accurate result assessed in Part 1

[Results of the study]

PART 1:

Pulse Rate (Hz)

80 Hz: Rising phase increased upon contraction of muscle and increased upon release. Pulse rate was decreased during the time where the controller's hand was contracted. Controller trend had two rising and falling phases before experiencing an undershoot followed by a rising phase. The resting phase which is circled in purple remains short because the controller did not contract muscles which ended the reaction.

50 Hz: Reaction of controls was slower regarding the controller. This is because the pulse rate was fifty, causing the prolonged reaction. Towards the end however, there had been a similar match in

pulse. There was a complete drop in pulse between the middle

70 Hz: Pulse rate was very accurate with both controller and control. Peaks and troughs throughout the set and it was mostly precise with some breaks within the pattern. Overall, there were only one significant undershoot along the middle of the controller and the controlled.

20 Hz: Results were inaccurate, and little rising phases as most of them were at constant, while some were not even shown. It is because the pulse rate was low hence the pulse was not effectively measured.

40 Hz: One rising and fall phase observed which was about the same time, however there had been a constant rest phase, in which there had been no transfer of electrical impulses

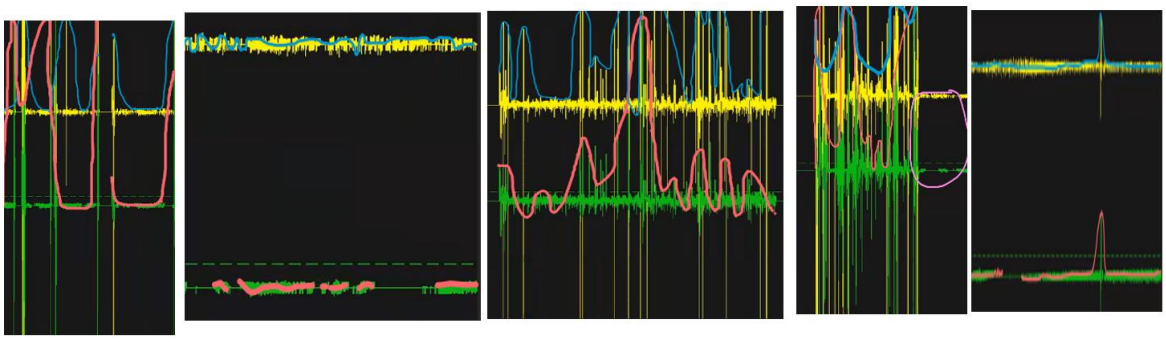
PART 2: There was little output of electrical signals at 70 Hz when it the UECGs were placed on the controller whilst it was connected to the robotic arm. The robotic arm had no movement; however, one motor did move. This may have been due to a human error, as there had been a short circuit within the adafruit.

[Conclusion]

The hypothesis for Part 1 was proven to be true as when the Pulse rate was at 70 Hz, the transmitter more accurately took control over the receiver. Contrary to this, for Part 2 the hypothesis was not proven, but it may have been due to a short circuit which took place in the adafruit. There was an output signal however it was small and not enough to control the prototype arm.

[Future study plan]

In the future to prevent the mishap of short circuiting, a resistor will be used to control the amount of current flowing through all the wires so that the components do not get overheated. Several people are unfortunate to not be able to have all four limbs. Hence this method is being researched to see whether it can be useful in society and how it can be efficient as well. If someone has an artificial limb, such as a robotic arm, they can use the electrical activity generated by the EGP signals in their pectoral muscles to control motors and systems within the robotic arm. This has been identified in Part B of the experiment, where a subject's nerve controls the arm of a robot. Jesse Sullivan was a prime example in the success of the cyborg arm, which she has been using and told the news that it had made her feel like "she was given a second chance." With this research it can be concluded that this robotic arm could be used as a prosthetic for victims of fatal accidents or issues where they have lost an arm or leg.



PH-04

Effect of the planetary magnetic field on the shape of gas giants' polygons based on fluid instabilities principle

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[Background]

In a region close to Jupiter and Saturn's poles, massive cyclones reorganize themselves to create a polygonal pattern. We hypothesized that the formation of the polygonal pattern from the cyclones may have resulted from the Lorentz force of both planets' magnetic fields due to an appearance of ionized hydrogen and helium gas in their atmospheres and the phenomenon's position located near the poles. In addition, fluid instabilities concepts and Coriolis force can be used to describe how gasses flow through the atmosphere.

[Purpose of the project]

Thus, we wanted to study the effect of magnetic fields on changes in Rossby Waveforms and to simulate a polyhedron cyclone experiment on Jupiter and Saturn in the laboratory to compare the result with the Rossby wave solution from the equation Navier-Stokes in a rotating frame.

[Methodology]

Initially, the magnetic field's intensity was varied in the Rossby wave simulation to examine atmospheric behaviors and vortex characteristics. The simulation's results were matched with those of a laboratory experiment in which a magnetic field was used to drive the flow of ions in a rotating tank comprising ionized salts to mimic Jupiter and Saturn's atmospheres.

[Results of the study]

From our findings in both simulation and laboratory experiment, we noticed that the magnetic field affects the position and size of the vortexes. The higher magnitude of magnetic field shifts the vortexes toward the pole and contributes them to shrink in size. The results are also in accordance with what happens in Jupiter in which Mura and his colleagues have researched. Compared with Saturn, Jupiter has smaller vortexed packing closely at its pole because of its higher magnetic intensity. From the experiment, the vortexes were unstable and ever-changing due to fluid instabilities. This aspect is also in congruence with the phenomenon where five cyclones rearranged themselves to be six cyclones surrounding the central vortex in 2019.

[Conclusion]

According to the observations, the size and location of vortexes appeared to be influenced by the strength of the magnetic field. The vortexes moved toward the center and shrank in size as the magnetic field's density increased. Additionally, due to the fluid's instability, the number of vortexes gradually decreased over time. These two aspects fit the atmospheric occurrence.

[Future study plan]

1) Improve the experimental setup to be bigger so that we can observe the changes of wave characteristics from the effects of the magnetic field more clearly.
2) Further analyze the density of solution to find the relationship between the charge density of Jupiter, Saturn, and our experiment.
3) Research in the modification of a solution to imitate the atmospheric surface of Jupiter and Saturn which are non-homogenous.
4) Analyze the formation of the magnetic field in the experiment and its value compared with the

simulation.
5) Improve the experimental setup to have an ability to adjust the magnetic field intensity.
6) Consider the heat convection term by varying the temperature to form the Rossby wave phenomenon.

[Keywords]
Rossby wave, Magnetic field, Jupiter, Saturn, Cyclones, Fluid instabilities

Figure 1(Left) Picture of a polygonal cyclone at Jupiter's south pole
Figure 2(Right) Experimental set

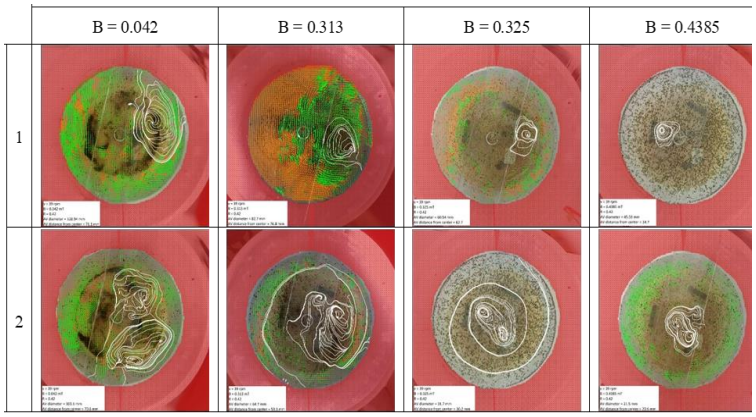

Figure 3 Results from PIVlab software

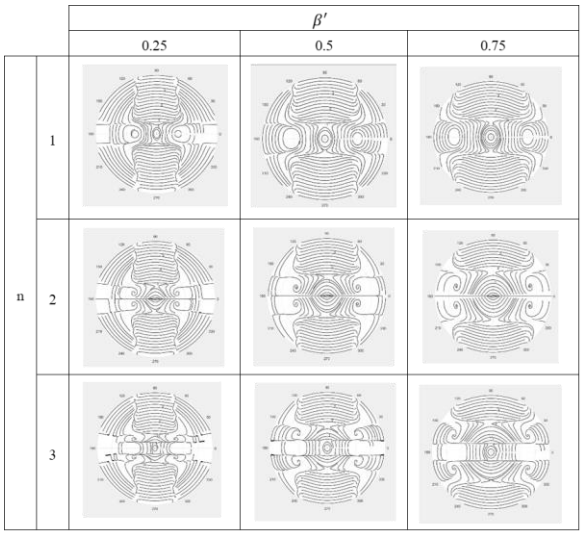

Figure 4 the characteristics of the Rossby wave generated by the *n* and *β′* adjustment

PH-05

Light pollution creates background noise which prevents the ability to see faint objects

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[Background]

Light pollution is the presence of light, usually artificial, that creates background noise, due to this, fainter astronomical objects cannot be seen. The light pollution level in Gawler was higher at approximately 20.6 magnitude/arc second², whereas Meldanda was lower at approximately 21.9 magnitude/arc second² (Light Pollution Map 2015). Gawler is a built-up suburb with lots of artificial lighting and Meldanda is an officially recognised dark sky site. The apparent magnitude, m, is the brightness of a star that is perceived by the observer. The magnitude doesn't have any units, it is just a number. The absolute magnitude, M, is the brightness the star would be if it were 10 parsecs away from an observer on Earth. The scale for both apparent and absolute magnitude is the same. The difference of one magnitude is 2.512 times the difference in brightness, this is a logarithmic scale. The lower the value of M, the brighter the star is (CSIRO n.d.). It was hypothesized that as the level of light pollution increases, the accuracy of measuring astronomical objects, such as finding the distance of variable stars, decreases.

[Purpose of the project]

To investigate the impact of light pollution on calculated distances to Cepheid variable stars.

[Methodology]

In this experiment, images of a part of the sky were taken using a telescope at Gawler and Meldanda. The images were used to find the experimental magnitude and then were compared to each other.

[Results of the study]

If the light pollution level is less than 20.6 magnitude/arc second², then measurements of stars with apparent magnitude greater than 11, will be inaccurate.

[Conclusion]

As the light pollution increases, the accuracy of astronomical measurements decreases.

[Keywords]
Light pollution, Cepheid variable stars, Photometry

PH-06

Diagnosis of hearing disease using pairs of auditory illusion words

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[Background]

Hearing problems caused by organ degeneration with age are common, causing many people to ignore and overlook the true cause of the problem. Nevertheless, the main cause of it is dysfunction of the auditory organs, including the part of the inner ear that connects to the brain. Early detection of the disease before severe symptoms occur may increase the chance of successful medical treatment and a complete recovery. Diagnostic tools, designed to be easy for people who are less technically oriented or whose hearing problems are suspected, are essential. After the "Laurel and Yanny" sound became a trend on Twitter, many people could hear different sounds. It was said that 53% heard the word "Laurel," and the other 47% heard the word "Yanny." The study showed that "Laurel" is a word with a low tone and "Yanny" is a word that combines "Laurel" with a high noise frequency. Therefore, the difference in hearing the auditory illusion words relates to the symptoms of hearing loss and hearing disease.

[Purpose of the project]

1. To create sets of auditory illusions that can identify the symptoms of hearing loss at an early stage and be the basis for further adjustment of auditory behavior.
2. To investigate the principles that can distinguish the auditory illusion terminology in the structure of sound waves and the part of human sound perception.

[Methodology]

The research team researched auditory illusions called "Laurel and Yanny" and used them to test the sample group (100 people, including 80 students and 20 adults) to find factors that affected hearing by listening to the auditory illusion and determining whether they could hear "Laurel" or "Yanny" or both or could not hear these words. The testing method was to let the participants hear the original controversial Laurel and Yanny sound wave (frequency range of 0–6500 Hz) and then remove some part of the spectrogram and let the participant hear the sound again five times (0–5500 Hz, 0–4500 Hz, 0–4000 Hz, 0–3500 Hz, and 0–3000 Hz once a time) and record the word that the participant could hear (the example of data collection is in the pictures section).

[Results of the study]

During the analysis, the research team found that the way to create auditory illusions was to transform the natural sound wave (N) to the same shape as the controversial sound wave (C) and use the same method to transform any word's sound wave into auditory illusions. From the test, it was found that the test subjects knew the results based on their assumptions, but there was still some speculation. The obstacles encountered were as follows:

1. Some people who had been tested were not familiar with the choice of words heard because of an English word.
2. When the person had been tested by listening to the test series several times, the test subject would hear both words. Therefore, they were unable to decide which word to choose.

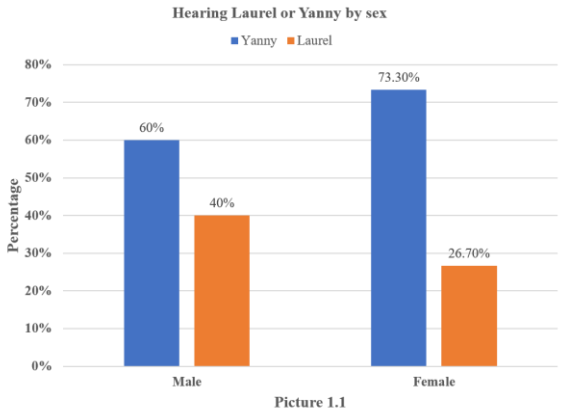
[Conclusion]

The difference in hearing the auditory illusion words related to the symptoms of hearing loss and hearing disease, which led to finding the factors that affected hearing, namely, age, sex, and workplace.

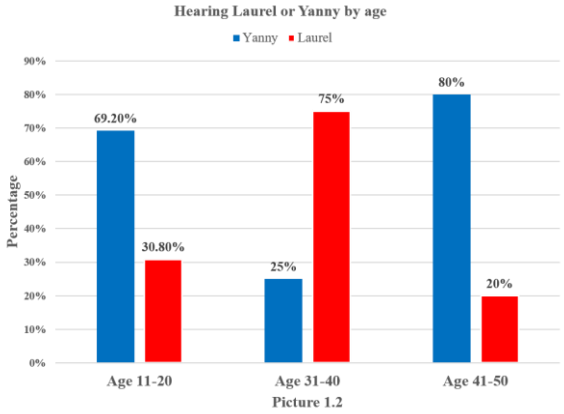
[Future study plan]

Develop an early hearing disease diagnosis tool for people who are less technically oriented or whose hearing problem is suspected, and create sets of auditory illusion words in the Thai language for patients who can speak Thai.

[Keywords]
Auditory Illusions, Sound tone, Hearing Disease

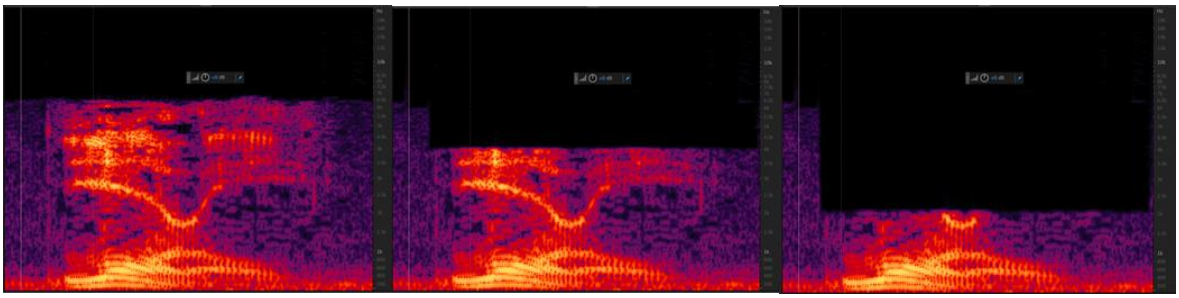


Picture 1.1



Picture 1.2

Picture 1 - Data collecting by recording participants,
(1.1) Hearing compared with sex and (1.2) Hearing compared with age ranges



PH-07

Heavy metal (Zinc) measurement machine in RGB color systems with chelate rutin

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[Background]

Heavy metals are one of the toxic substances that are harmful to humans, animals, nature and the environment. These water bodies are often contaminated with heavy metals. According to the analysis of heavy metal content in water resources of industrial, agricultural, and livestock areas in Thailand, it is found that Many heavy metals such as copper (Copper-Cu), cadmium (Cadmium-Cd), lead (Lead-Pb), nickel (Nickel-Ni) and especially the heavy metal zinc (Zinc-Zn) are found in amounts up to 161.37 mg/m. liter while in water sources, the concentration of heavy metal zinc should be no more than 5.0 milligrams per liter If it's too much, it's very dangerous to human. The study found that there are many methods of zinc heavy metal analysis, such as AAS, where rutin is a bidentate ligand that can bond with zinc heavy metal to form a yellow-brown complex with stability This makes it easy to analyze and verify. Based on this information, the authors came up with the idea to develop a zinc heavy metal detector in the RGB color system with chelatedrutin. To reduce the cost of building a heavy metal zinc detector. It can be more portable and easier to use.

[Purpose of the project]

1. To design a chelated rutin-based zinc heavy metal detector in RGB system.
2. To fabricate a chelated rutin-based zinc heavy metal detector in RGB system.
3. To test the detector performance.
4. To compare the zinc heavy metal concentration in RGB color system with chelated rutin and spectrophotometric techniques.

[Methodology]

1. Study of the angle of the light source to find the optimum conditions.
2. Study of distance from position Set the light source to the position of the sample.
3. Study to determine concentration range of zinc chloride solution ($ZnCl_2$) to find standard curve range.

[Results of the study]

The addition of zinc chloride in various concentrations yielded linear curves in the range of 10, 20, 60 and 80 mmol/L for accuracy and precision, given the SD value of green scattering (Green = G) at concentrations of 40 and 80 mmol/L, equal to 1.53, and red light scattering (Red = R) gave a decision coefficient of 99 percent in the green light scattering system (Green = G) at concentrations of 40 and 80 mmol/L. G) gave a decision coefficient of 99 percent, and in the blue light scattering system (Blue = B), a decision coefficient of 98 percent was given, which is like that of a mechanical measurement as same as Spectrophotometer.

[Conclusion]

From the experiment, it was found that the zinc heavy metal detector by measuring the intensity of the light scattering in the RGB color system, a method developed by the authors, was able to accurately measure the amount of zinc metal. It can also be measured. It's fast and easy to carry and reduce production costs.

[Future study plan]

1. Added Bluetooth for easy data reception.
2. An LED screen is installed on the device to display the number in time.
3. Create a database of each substance, allowing the machine to measure every substance.

[Keywords]

RGB color system, Coefficient of Determination

PH-08

Agricultural drone

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[Background]

Drones are an effective tool for farmers and agronomists in assessing crop health. They can get a better view of their fields and collect data much faster and more efficiently with drones than with traditional methods. Farmers will be able to use drones to see how healthy their plants are, where they may need water or nutrients, and if there is any pest activity before it becomes out of control.

[Purpose of the project]

- To reduce water stress and the chemical use in agriculture
- To assist to flight with climate change
- Reduce human worker
- Time and cost saving
- More income benefits
- To improve agriculture system in SEA

[Methodology]

- survey village map (Flight planning)
- turn on drone (power switch)
- start to fly (large motor)
- stop at the calculation high level (laser sensor)
- fly at speed that's been define (speed sensor)
- balancing while containing liquid/solid (gyro sensor)

[Results of the study]

According to our research, a drone can do more than just take pictures and videos; it can also help us in many ways to make our jobs easier, such as our topic drone can help in agriculture and much more. It aids in the reduction of the use of fossil fuels, chemical substances, and fertilizers in agriculture.

In addition, it is also resistant to high temperatures and waterproofing, It is a good investment and suitable for agriculture.

[Conclusion]

To summarize, if we can do all of this, we will be able to cure many things such as global warming, air and water pollution, less water usage per day, business payments, and increase agriculture in SEA so that we can export more food and make numerous financial gains in order to develop our own country as well as meet the needs of modern farmers and pave a new path with a functioning agriculture system in Lao PDR.

[Future study plan]

Nowadays drones are expensive. As a result, we will research and look for lower-cost materials while maintaining the same quality.

[Keywords]
Drone, Agriculture, Plant disease, Reduction of water usage, Reduction climate changes.

PH-09

The process of biotechnical product development with the example: resistance clothing

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[Background]

We live in a world where you can't physically keep up with all the new technological advancements and the newly developed products. We did research on how companies can develop products most efficiently and used an example to draw a roadmap, whereby we got a better picture on how the steps work.

We developed the STRUNG-shirt, this is a shirt which is filled with resistance bands who create resistance against all the movements that a body part can make out of the neutral position of the muscles. The development went by specific steps which are explained.

[Purpose of the project]

Our purpose as a group was to do research about topics, all members of our group were interested in. Because we chose to use an example to explain all of these steps above, we got to research various aspects like:

- Different types of movements with various joints within our bodies (Biology)
- The differences in the bodies of man and woman (Biology)
- Water vapor conduction of various materials (Physics)
- Thermo-physiological comfort of various materials (Physics & Chemistry)
- Elastic recovery of types of rubber (Physics & Chemistry)

[Methodology]

First, we asked ourselves three questions:

1. What are the steps followed within the development of a biotechnical product?
2. What are the technical specifications of a biotechnical product?
3. How do you protect your concept and market your product?

[Results of the study]

1.

a. Thinking of a concept
b. The design and technical realization of the product
c. Testing, collecting consumer feedback, requirements and wishes
d. Processing this feedback into a final end product
e. Marketing and protecting the product through legislation
f. Presenting and releasing the product

2.

Biotechnical products distinguish themselves from normal products, because for a biotechnical product, research and development is a requirement

3.

Marketing: You market your products efficiently by setting up a marketing plan based upon the target audience you want to reach, this requires a good understanding of your product.

Protection: A product can be protected by various means dependent on the type of product you got. Our "Resistance Clothing" for example will be protected by a non-disclosure agreement, various patents & trademarks.

[Conclusion]

At the end, we had a great roadmap of how biotechnical product development looks like. As a byproduct, we had the design of the “Strung shirt” which would work out the upper body with the use of elastic bands (pictures below) and enhanced the visualization of it all.

[Future study plan]

We unfortunately couldn’t produce it, but we made a low-budget prototype, that gets the point across (pictures below). In the future we could contact a factory to produce our item. This would give us the opportunity to test our product and conclude if all the aspects which we researched are true.

[Keywords]
Product development, Biology, Physics

PH-10

The study of dynamics of falling Mahogany *Swietenia macrophylla* seeds for the development of guidelines for helping victims of flood

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[Background]

Flooding is a disaster that affects a wide range of mortality rates in the population, economy, and society. At present, there are two solutions: policy and field trips. which is to help the victims through water and air, however, both These methods are also limited in terms of inaccessibility in certain areas of Efficiency, Results, Duration, and Accuracy. Therefore, the researcher is interested in studying the phenomenon of rotation of mahogany seeds.

[Purpose of the project]

1. Modelling the mathematical expression that can explain the falling of Swietenia macrophylla seeds
2. Study the aerodynamical properties of Swietenia macrophylla shape for the potential of developing guidelines for helping victims of flood

[Methodology]

1. Modelling the falling of mahogany seeds using the torque equation

Our assumption is that the impulse force acting on the seed is caused by a continuous single air particle. Then we use the impulse force due to air to find the torque of the falling seed

2. Study on the external morphology of mahogany seed

Preparing samples of mahogany seeds collected from Princess Chulabhorn Science High School Pathum Thani. To study the similarities and differences in samples, the mass was analyzed with a digital balance. Then, python was used to analyze the morphology of the wing.

3. The relationship between mathematical expression and experimental data

We use the measured data from the previous study to test if the mathematical expression that we derived is correlated with experimental data

4. Aerodynamical properties of Swietenia macrophylla shape

Mahogany seeds were studied through computational fluid dynamics through simulations in the COMSOL Multiphysics program.

[Results of the study]

1. Modelling the falling Swietenia macrophylla seeds using the torque equation

We derived the mathematical expression that explained the falling seeds by using torque equation

$$\tau = \frac{1}{2}\rho l\omega^2 R^4(1 + cos\ cos\ 2\theta\ )$$

2. Study on the external morphology of mahogany seed Swietenia macrophylla

From the study of the external morphology of mahogany seeds, it was found that mahogany seeds could not be classified. But we could predict the general form of seeds using the normal distribution.

3. The relationship between mathematical expression and experimental data

We found that the mathematical expression derived from the torque equation is correlated to the experimental data (eg. Angular Acceleration)

4. Aerodynamical properties of Swietenia macrophylla shape

From the Contour graph, the airflow, both velocity and pressure, it can be concluded that the mahogany grain is an ideal shape for flying because the velocity and pressure fields of air flowing around the wings that allow the wings to fly well can be explained by the Bernoulli Equation.

[Conclusion]

It was found that we could use the torque equation to model the falling Swietenia macrophylla seeds and the factor that can affect the rotation is the drop height. degree of release Characteristics of mahogany seeds and the position of the release. Through computational fluid dynamics simulation in COMSOL Multiphysics. It was found that when constructing it as a function of drag coefficient and lifting relative to time It has been shown that the shape of the mahogany grain is effective in flight, making it possible to apply it as a high-precision flood rescue device.

[Future study plan]

Using Reynolds transport theorem or different approaches to estimate the air that collided into seeds and study the efficiency of the design of airborne survival bags from the application of mahogany seeds in real situations.

[Keywords]
Dynamics, Rotational motion, Mahogany seed, Autorotation

PH-11

Supernovae type Ia and cosmic distance measurement

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[Background]

The distance of objects in the universe is so far that it is not possible to measure them with everyday tools. One of the measurement tools that cosmologists use for this purpose are supernovae. A supernova is actually the end of the life of stars that have several times the mass of the sun and terminate their life with an explosion. Supernovae are known as standard candles due to their specific intrinsic luminosity. This feature, together with the inverse-square law, allows astronomers to measure the distance of supernovae by measuring their light intensity. In this article, we first study the inverse-square law by conducting an experiment and see that the greater the distance from light source, the more the light source from us, the more surface of the space is illuminated. So as a results of less incident light rays received by one unit area, the distance surface unites seam dimmer than the close ones. In fact the intensity of light decreases inversely by the square of the distance from the source. Designing a set up, with fallow what astronomers do to measure the distance of a supernovae.in this experiments, replace a camera at different distances from a light source and take some photos of the lamp. By processing the images and using inverse square law, we measure the distance of camera from the source. Our results are in good agreement with what we have measure by a tape meter. by photographing a specific lamp at different distances and processing its images, we measure the distance of the lamp. The obtained distances are in good agreement with what we had measured with the tape meter.

[Purpose of the project]

How can one measure long distances in the scale of the cosmos? Have you ever wondered how to measure long distances between objects in the universe, with meters or rulers or engineering laser meters?! None of them are possible; to measure this distance, astronomers use different methods, one of which is the use of the supernovae's light.

In the past, there was a time when the distances of cosmic objects were not well known, or the lifetime of the universe was estimated to be a few billion years. Because the cosmic measurements and Hubble's parameters were not well known. Today, we can say that the age of the universe is about 13.8 billion years, and we can also determine the distance of objects. Scientists use three main methods to measure cosmic distances: 1) Parallax for nearby stars, 2) Cepheid variable stars for globular clusters and nearby galaxies, and 3) Type Ia supernovae for distant galaxies. Type Ia supernovae and Cepheid variable stars are known as standard candles for distant measurement.

In this article, the main goal is to understand how to measure distance in cosmic scale using supernovae. In this regard, we will first understand the inverse-square law and measure the distance using this law, and then we will study how to measure the distance using supernovae. Finally, by conducting an experiment, by having different images of a specific lamp at different distances, we determine the distance of the lamp in different images, in the same way that the light of supernovas is used for distance measurement.

[Conclusion]

In this research, after the initial studies, we have first conducted an experiment to understand the concept of the inverse-square law. Then, similar to what astronomers do, to measure the distance of supernovae, by photographing the same lamp at different distances, we measured the light received from it and obtained their relative distance using the inverse-square law. In this

section, we describe these experiments.

Cosmic distances are so long that it is not easy to measure them with tools such as rulers, meters, etc. The light of supernovae is a tool that makes this possible. Supernovas are the final explosions of massive stars that have several times the mass of the sun. One of the ways to measure cosmic distances is to use the intrinsic light of supernovae, which are called standard candles because of their constant intrinsic light.

In this research, we conducted two experiments to understand how to use standard candles. In the first experiment, to show how light is emitted from a bright source, we considered a lightbulb as a supernova and placed a surface marked by one-centimeter squares as the surface where the light reaches. We observed that the number of squares that were illuminated increased with the square of the distance, and therefore the light that reached each square decreased. The equation between the received light intensity and the distance is obtained using the formula $L = S4\pi r^{-2}$. Our experiment is also consistent with this relationship.

After we understood the inverse-square equation, we wanted to know how astronomers measure the distance of supernovae by having images of them. For this purpose, in the second experiment, we first considered a lamp as a supernova with constant light and then photographed it at certain intervals. The format of the photos must be raw and not being processed by the camera. For this purpose, we used the iPhone 11 camera and the Raw+ application. Then we converted the raw photo into *.fits* and then analyzed the data with the ImageJ program. You can see the data in Table 1 and see the analysis and plots in Figures 3 and 2. In order to know how accurate the results of our calculations were, we fit a straight line to the data. The closer the slope of this line is to one, the closer the measured distance is to the actual value. As we expected, the image of the first lamp was not a good measure for measuring the distance due to the light reflection in the camera lens, and we obtained more accurate results by using the second lamp. In this way, we measured the distance of our.

[Keywords]
Supernova, Inverse-square law, Light emission, Cosmic distance measurement, Image processing

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PH-12

Trial of power generation using river sludge

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[Background]

Rivers, swamps, and lakes in Japan are currently polluted by domestic wastewater, agricultural wastewater, and discarded garbage. At the same time, non-native species are threatening the survival of endemic species. In particular, the proliferation of non-native species of floating weeds, water hyacinths, and algae prevents sunlight from entering the water, causing other plant species to die, which in turn degrades the environment for fish, crustaceans, and other animals.

[Purpose of the project]

In rivers, swamps, and lakes where this has occurred, the mud on the bottom of the water becomes sludge. We wondered if we could recycle the mud that had turned to sludge.

[Methodology]

As a way to reuse river sludge, we wondered if we could generate electricity using bacteria living in the mud. Since the amount of electricity generated at this time is miniscule, we devised a way to increase the amount of electricity generated by using porous materials.

[Results of the study]

We used charcoal as a porous material that is familiar and easily accessible to Japanese people, and found that it can increase the efficiency of power generation depending on how it is used.

[Conclusion]

We have found that mixing charcoal with sludge can increase the efficiency of power generation.

[Future study plan]

Unfortunately, the power generation capacity of sludge is extremely small. However, it may be possible to increase the amount of electricity generated by mixing large amounts of mud with large amounts of porous materials. We used charcoal as an example of porous material in our study.

Charcoal is expensive when used in large quantities, so a less expensive porous material that can increase power generation efficiency is needed.

[Keywords]
Sludge, Porous material, Charcoal, Bacteria

PH-13

Classification of the ripeness stage of 'Nam Dork Mai' mango using density value and 3D object volume approximation

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[Background]

The "Nam Dok Mai" mango is widely grown in Thailand and is popular for consumption. Moreover, it is exported to many countries in Asia and Europe and make the money for our country. Ripe mangoes have a pleasant flavor and aroma. However, overripe mango fruit has lower or even no retail value, resulting in severe profit loss and resource waste. So, the classification of mango fruit according to ripeness stage is important for successful marketing. During ripening, the mango fruit undergoes several changes, including the conversion of starch to sugars which should be effect on the density of mango. From this concept, our study does the experiment and collect the data where the results present an approach to assess the ripeness stage of "Nam Dok Mai" mango using the density value of mango.

[Purpose of the project]

This project aims to investigate the relationship between the density of mango and its ripeness stage based on volume estimation using three-dimensional shapes

[Methodology]

In this work, the various data of mango, such as the sweetness and the color of peel were collected. Then we determined the mango's ripeness stage which relates to these data. The relationship between the density of mango and the degree of ripeness was also determined. Normally, density is obtained by dividing the mass by volume. In this work, the volume of mango was estimated from the rectangular box volume. The widest, longest, and tallest sides of the mango indicate the width, length, and height of a rectangular box, respectively. However, the approximation of the volume of a non-geometric figure such as the mango is inevitably inaccurate due to some space. So, we repeated the experiment to find the percentage difference between the rectangular box volume and the mango volume and then used that value to estimate the volume of mango. From all the data, a forecast formula has been established which can determine the ripeness level of mango.

[Results of the study]

From our study we found that the ripeness stage of mango depends on the amount of total soluble solid which related to the density of mango. The density of mango increases with the increase of total soluble solid and we can determine their relationship using polynomial equation. To approximate the volume of mango, we found that the volume of mango around 43% of rectangular volume where the widest, longest, and tallest sides of the mango indicate the width, length, and height of a rectangular box, respectively. By combining these data, we can determine the ripeness stage of mango using only mass, the widest, longest, and tallest sides of the mango.

[Conclusion]

In this work, the relationship between the density of mango and the ripeness stage was determined. From the experiment the polynomial equation can represent this relation. To find the density of mango we use 3D object volume approximation technique and we found that the volume of mango around 43% of rectangular volume where the widest, longest, and tallest sides of the

mango indicate the width, length, and height of a rectangular box. Finally, we can forecast the ripeness stage of ‘Nam Dork Mai’ mango base on the combination of these relations.

[Future study plan]

For the step, we plan to develop the prototype set up to determine the ripeness stage of mango based on the equation that we get from the experiment. For the prototype, we will use two types of sensor to measure the weight and length of mango including the widest, longest, and tallest sides of the mango. These data will send to the KidBright board to process and approximate the ripeness stage of mango which show the result on LED display

[Keywords]
“Nam Dork Mai” mango, Degree of ripeness, Volume estimation

TISF 2023 Participants

No.	Countries & Economies	School
1	Australia	Australian Science & Mathematics School
2		John Monash Science School
3	Cambodia	New Generation School Preah Sisowath High School
4	China	Experimental School of Beihang University
5	Hong Kong	G.T. (Ellen Yeung) College
6	India	Vasant Valley School
7	Iran	Manzoumeh Kherad Institute
8	Israel	Leo Baeck Education Center
9	Japan	Ritsumeikan High School
10		Senior High School at Komaba, University of Tsukuba
11		Tokyo Tech High School of Science and Technology
12		Waseda University Honjo Senior High School
13	Korea	Hana Academy Seoul
14		Korea Science Academy of KAIST
15		Seoul Science High School
16	Lao P.D.R.	Vientiane Secondary School
17	Netherlands	St. Odulphuslyceum
18	Philippines	Bansud National High School – Mimaropa Regional Science High School
19		Philippine Science High School – Main Campus
20	Russia	Advanced Education and Science Center of Moscow State University (The Kolmogorov School)
21		Moscow South-Eastern School named after V.I. Chuikov
22	Singapore	Anglo-Chinese School (Independent)
23		National Junior College
24		National University of Singapore High School of Math & Science
25	United Kingdom	Camborne Science and International Academy
26	Thailand	Demonstration School of Khon Kaen University, Secondary (Suksasart)
27		Demonstration School of Khon Kaen University, Secondary Level (Mo din daeng)
28		Demonstration School Prince of Songkla University
29		Demonstration School University of Phayao
30		Islamic Sciences Demonstration School, Prince of Songkla University
31		Kamnoetvidya Science Academy

No.	Countries & Economies	School
32	Thailand	Kasetsart University Laboratory School Center for Educational Research and Development
33		KOSEN - KMITL
34		KOSEN - KMUTT
35		Lukhamhanwarinchamrab School
36		Princess Chulabhorn Science High School Buriram
37		Princess Chulabhorn Science High School Chonburi
38		Princess Chulabhorn Science High School Loei
39		Princess Chulabhorn Science High School Lopburi
40		Princess Chulabhorn Science High School Mukdahan
41		Princess Chulabhorn Science High School Nakhon Si Thammarat
42		Princess Chulabhorn Science High School Pathum Thani
43		Princess Chulabhorn Science High School Phetchaburi
44		Princess Chulabhorn Science High School Phitsanulok
45		Princess Chulabhorn Science High School Satun
46		Princess Chulabhorn Science High School Trang
47		PSU.Wittayanusorn Surat Thani School
48		Surawiwat School, Suranaree University of Technology
49		Triam Udom Suksa School
50		Mahidol Wittayanusorn School


Mapping Out the Future