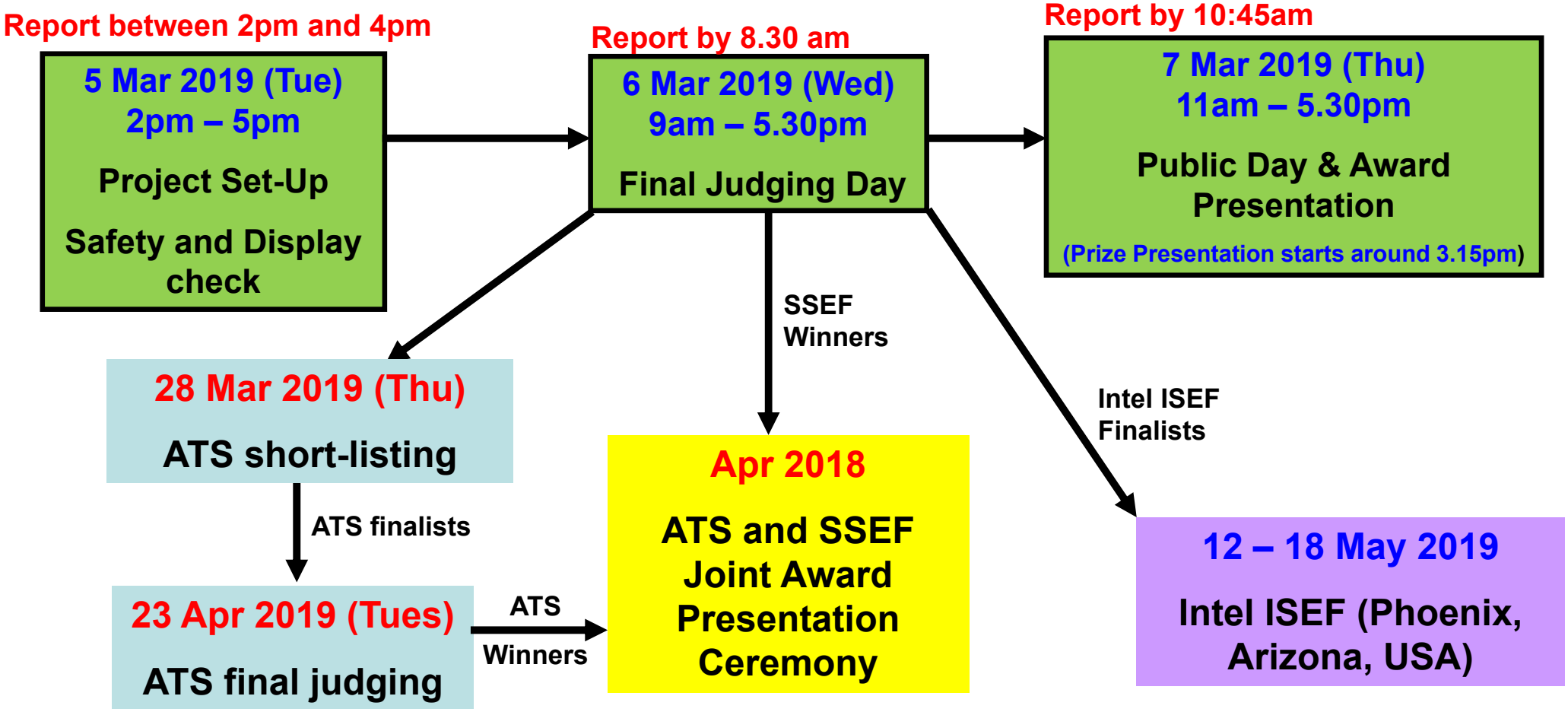
SSEF, ATS & Intel ISEF Briefing

20 Feb 2019 (Wed)

National Junior College


Report between 2pm and 4pm
5 Mar 2019 (Tue)
2pm – 5pm
Project Set-Up
Safety and Display check
Report by 8.30 am
6 Mar 2019 (Wed)
9am – 5.30pm
Final Judging Day
Report by 10:45am
7 Mar 2019 (Thu)
11am – 5.30pm
Public Day & Award Presentation
(Prize Presentation starts around 3.15pm)
SSEF Winners
Intel ISEF Finalists
28 Mar 2019 (Thu)
ATS short-listing
ATS finalists
23 Apr 2019 (Tues)
ATS final judging
ATS Winners
Apr 2018
ATS and SSEF Joint Award Presentation Ceremony
12 – 18 May 2019
Intel ISEF (Phoenix, Arizona, USA)

Important Information

Dates

- 5 Mar Tues PM: Project set-up, safety and display check
- 6 Mar Wed: Final Judging
- 7 Mar Thurs: Public Day and Awards Presentation

Venue

- Our Tampines Hub (nearest MRT: Tampines)
- Community Auditorium, Level 3

Directions

Legend

Car route — Walking pathway

Bus stand — MRT

Getting to OTH by Car:

The Basement 2 Car Park can be accessed by Entrance A & C, via Tampines Avenue 4 & 5 or via Tampines Walk. The Basement 1 Car Park can be accessed by Entrance B (see directions outlined above)

Getting to OTH by Train:

Alight at Tampines MRT Station (DT32, EW2) (approx. 5 min walk)

Getting to OTH by Bus:

Bus stop A & B - 3, 10, 20, 22, 23, 31, 34, 39, 65, 67, 292, 293

Bus stop C - 22, 293

Getting to OTH by Taxi:

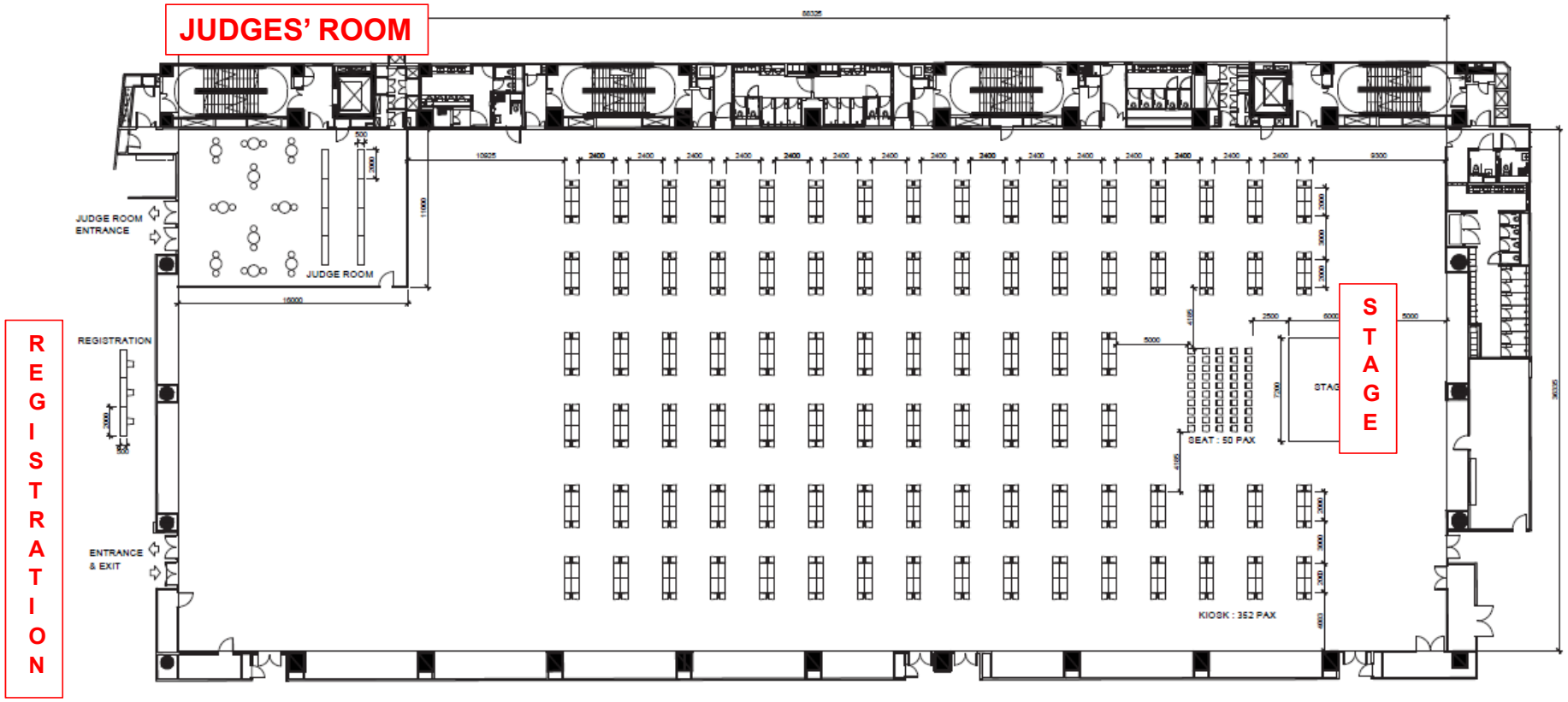
The taxi stand is at North Arrival Plaza via Tampines Walk and Arena @ OTH via Tampines Street 82

North Arrival Plaza Taxi stand number: **i51**

Arena @ OTH Taxi stand number: **i50**

For more info: http://l.ead.me/bavNB4

Exhibition Layout



Project Set-Up

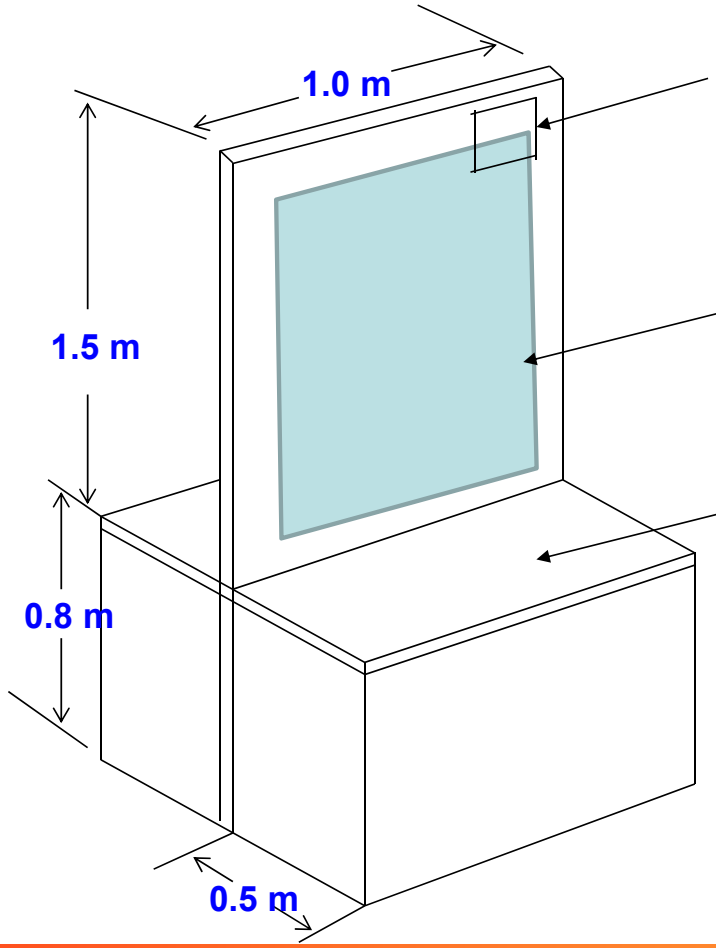
(5 Mar 2019, Tues, 2pm – 5pm)

Report at OTH between 2 – 4 pm to take attendance and confirm booth number

Items to Prepare:

- All display materials (poster and exhibits)
- Velcro tape (with double sided adhesives) for mounting of poster
- Copies of abstract (for judges & visitors)
- Form 1C, 7 if applicable
- Paper and tape to cover up logos / acknowledgements if applicable

Display Booth



Project ID/
Booth Number
(will be provided)

(30cm wd x 11cm ht)

Poster to be kept within dimensions allowed: Max A0

For Laptops, display of exhibits (not exceeding area of table)

One 5-amp electrical point will be provided at each booth

Log Book and supporting documents highly recommended

Items at Display Booth

You are **not allowed** to display

- awards / medals,
- business cards,
- flags,
- logos (including names of schools and research institutes),
- CDs,
- endorsements and/or acknowledgements (graphic or written),

or have them on any display item (including poster, laptop, log book), during Final Judging Day.

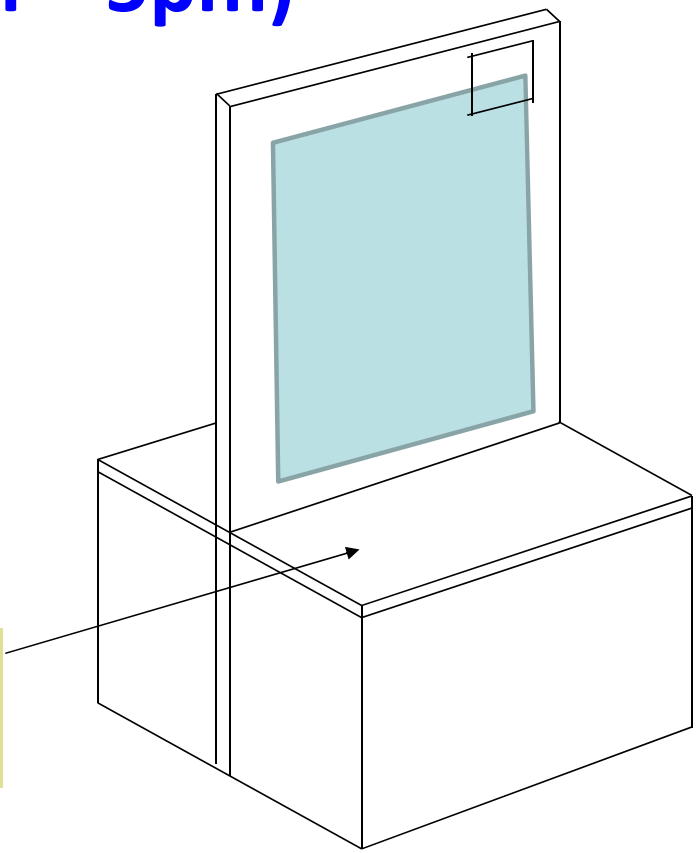
Items at Display Booth

- Refer to Intel ISEF 2019 – Display and Safety Regulations for details
- https://sspcdn.blob.core.windows.net/files/Documents/SEP/ISEF/2019/Rules/Book.pdf

- **Form 1C** must be vertically displayed on the booth *(for projects done in Regulated Research Institutions, e.g. A*STAR, NUS, NTU, etc.)*
- **Continuation project** must have continuation project **Form 7** vertically displayed

Project Set-Up
(5 Mar 2019, Tues, 2pm – 5pm)

- **<u>WARNING</u>: Do not stand on the table when putting up your poster**
- Keep your booth and its surroundings clean and tidy
- No valuables (including laptop) should be left at OTH overnight



Project Set-Up
(5 Mar 2019, Tues, 2pm – 5pm)

- Look for SSEF officials to inspect your booth
- Stickers will be given for every item cleared for display
- **Booths must be approved before judging commences**
- After clearance, no changes to the booth are allowed without approval from SSEF officials
- Students must leave the hall by 5 pm

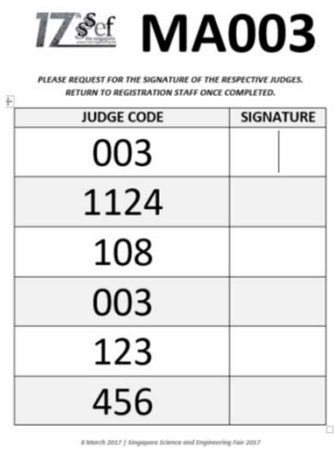
Final Judging Day (6 Mar 2019, Wed)

- **9am – 5.30pm** (all participants must be present)
- Registration starts at **8.30am**
- Attire – **School uniform with blazer**
- Collect your SSEF ID tag & collar pin and wear them at all times
- Bring your student pass for ID verification

Final Judging Day (6 Mar 2019, Wed)

- Packed lunch will be provided for all finalists @ Our Tampines Hub
- Lunch: **1pm – 2pm**

- With the exception of lunch, remain at your booth until your project has been judged by all assigned judges.
- Judges will sign on your card (to be given to you on 6 Mar).
- Proceed to registration booth with the card after your project has been judged by all assigned judges. You can go home after that.
- If you need to go to the restroom, inform participants next to your booth and return promptly.


MA003

PLEASE REQUEST FOR THE SIGNATURE OF THE RESPECTIVE JUDGES.
RETURN TO REGISTRATION STAFF ONCE COMPLETED.

JUDGE CODE	SIGNATURE
003	
1124	
108	
003	
123	
456	

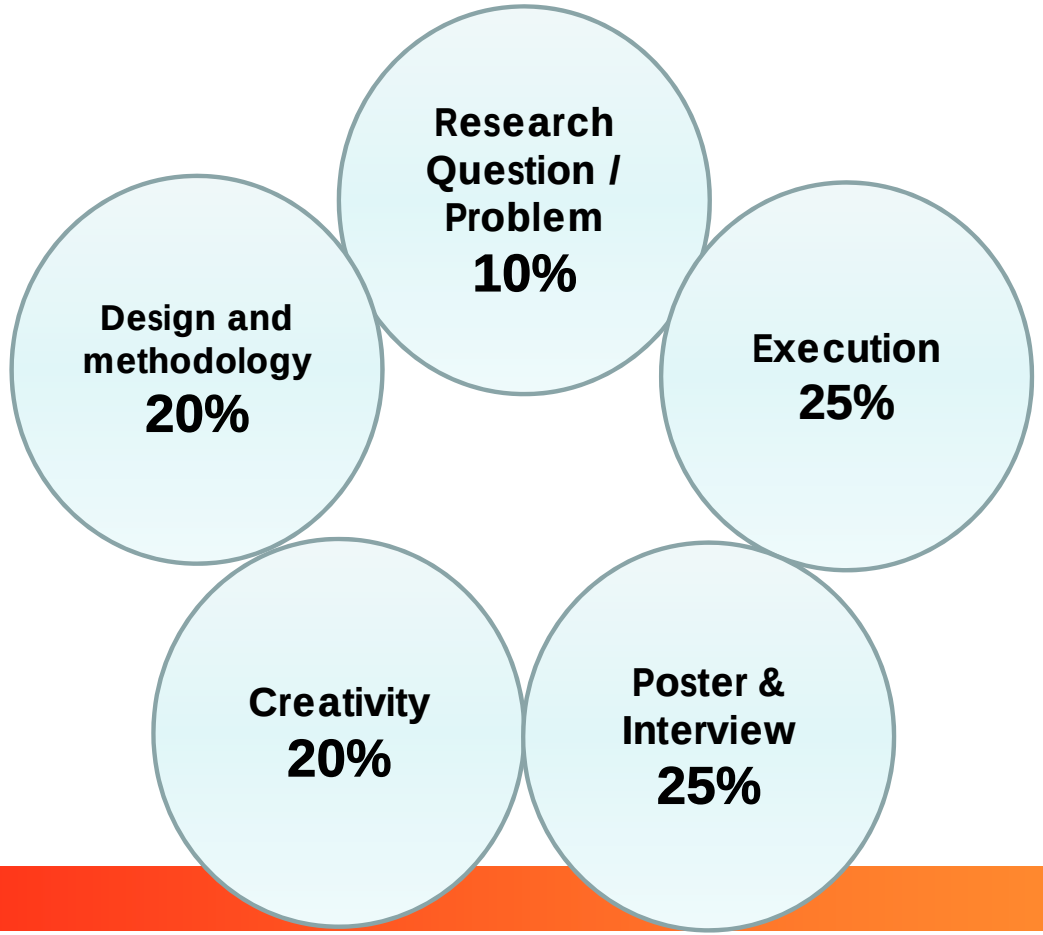
Final Judging Day (6 Mar 2019, Wed)

- You may bring reading materials but games, cards and expensive personal items are not allowed.
- Do not remove the display posters from the booth at the end of the day.
- Keep booth and area around tidy and clean.
- Do not block walkways or create traffic.
- Keep noise level down at all times and be considerate for others.

Advice for Final Judging Day

- Don’t deliver a lengthy monologue
- Keep your presentation to about 3 min: focus on the unique ‘selling’ point of your project
- Judges may interrupt your presentation at any time to ask questions, so be alert and adaptable
- Be polite to judges at all times; seek to clarify if you are unclear
- Take this opportunity as learning from experts in the field of your research

Judging Criteria for SSEF 2019



https://www.science.edu.sg/for-schools/competitions/singapore-science-and-engineering-fair

Public Day (7 Mar 2019, Thurs)

- Open to schools & the public from **11.00am to 5.30pm**
- Encourage teachers, students, friends and relatives to visit the Fair – Free Admission!

- **Report at registration booth by 10:45am**
- Attire – School uniform with blazer, wear your SSEF ID Tag at all times
- Packed lunch will be provided for all finalists @ Our Tampines Hub
- Lunch: **12 pm – 1 pm**

Public Day (7 Mar 2019, Thurs)

- Be present at your booth and engage visitors by explaining your project to them
- Be polite at all times: you are an ambassador of your school

- Results of SSEF 2019 will be announced starting around 3.15pm:
  - Special Awards, Gold and Intel ISEF will be announced at the central stage

- Project tear down immediately after prize presentation.
- All students must leave the hall by 6pm.

SSEF Awards

Award	Individual	Team (Graduated Increase)
Gold	S$400 vouchers + Trophy + Cert	2pax: $600 3pax: $800
Silver	S$250 vouchers+ Trophy + Cert	2pax: $375 3pax: $500
Bronze	S$150 vouchers + Trophy + Cert	2pax: $225 3pax: $300
Merit	S$100 vouchers + Cert	2pax: $150 3pax: $200
Special	Variable	

SSEF Special Awards

- To recognise projects that excel in areas beyond the scope of the judging criteria
- Sponsored by external organisations:
  - Institution of Chemical Engineers Singapore (IChemE)
  - Singapore Association for the Advancement of Science (SAAS)
  - Singapore Society for Microbiology and Biotechnology (SSMB)
  - Singapore University of Technology & Design (SUTD)
  - The Electrochemical Society, Singapore Chapter (TES)
  - Yale-NUS
- Judging criteria is decided by the organisation

Intel International Science and Engineering Fair (ISEF) 2019

- 6 SSEF projects will be chosen to represent Singapore at **Intel ISEF 2019** in **Phoenix, Arizona, USA** (12 – 18 May 2019)
- Students must be Singaporeans or PRs
- More information at: https://student.societyforscience.org/intel-isef

Pre-Judging Comments

- Provide students and teachers with qualitative feedback from judges
- Learn from strengths; work on areas of improvement

- Judges' comments should not be used to challenge the outcome of the projects
- Judges' decisions are final and no further correspondence will be entertained

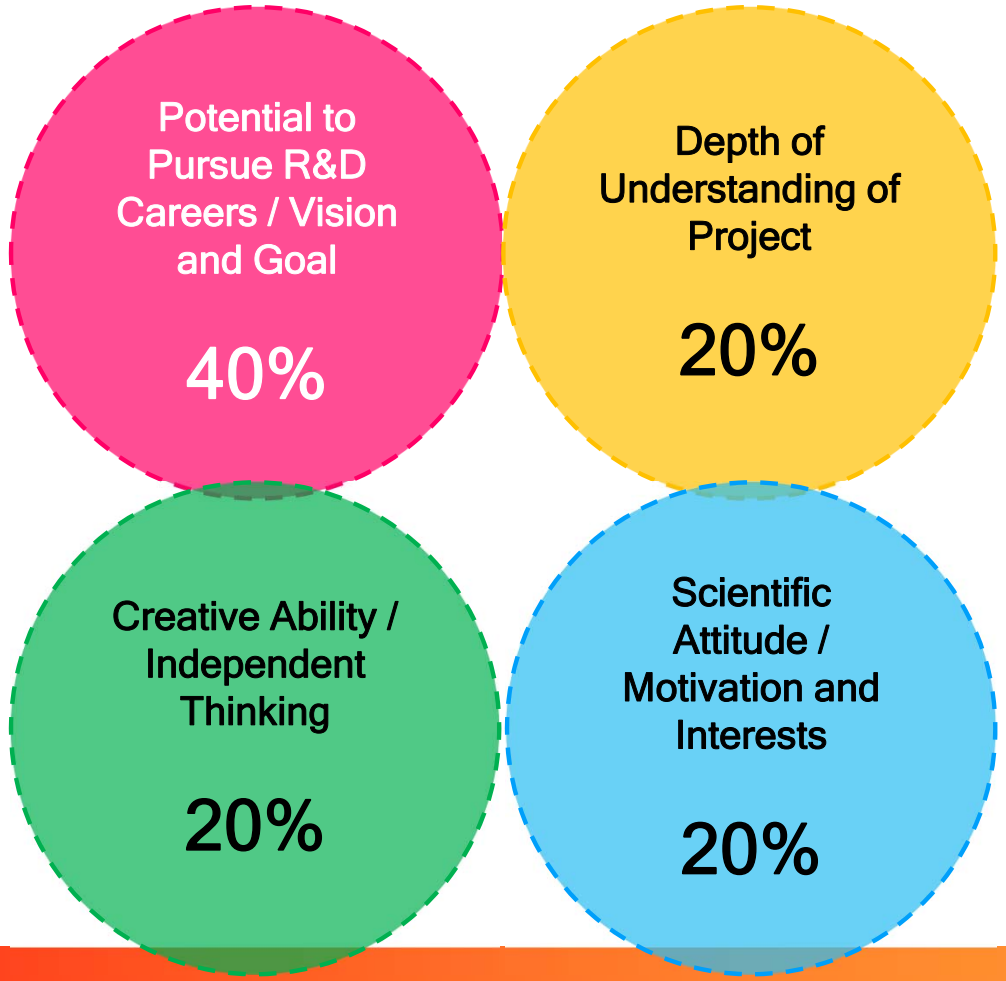
Contacts

Ms Pamela Loke	Pamela_LOKE@science.edu.sg	For SSEF & ATS Matters
Mr Koh Siak Peng	KOH_Siak_Peng@moe.gov.sg	For SSEF Matters
Mr Wong Yih Check	WONG_Yih_Check@moe.gov.sg	
Ms Yang Yarong	YANG_Yarong@moe.gov.sg	
Ms Gerlynn Yap	Gerlynn_YAP@moe.gov.sg	

A*STAR Talent Search Short-listing (28 Mar 2019)

- Only SSEF participants who have won a **bronze, silver or gold award** will be invited for the short-listing round.
- You will receive an email notification **before 15 March 2019** with the judging schedule and venue.
- Short-listing will take the format of **15 min interviews** (5 min presentation, 10 min Q&A) with a panel of judges.
- Bring your **project poster** and **log book** to show to the judges.
- Only **one member** from each team is eligible (new rule since 2016)

ATS Scoring Scheme



ATS Final Judging (23 April 2019)

- **8 finalists** will be invited for the final judging round.
- Finalists will receive an email notification **before 5 April 2019** with the judging schedule and venue.
- The final judging will take the format of **25 min interviews** (5 min presentation, 20 min Q&A) with a panel of judges.
- Prepare a 5 min **PowerPoint presentation** for the interview.

- Chief Judge - Prof Kurt Wuthrich (Nobel Prize Winner, Chemistry 2002)

ATS Awards 2019

Award	Prize	Points allocated to school
First	Cash prize plus a sponsored trip to overseas conference worth S$5,000 in total + Trophy + Certificate	5
Second	S$3,000 + Trophy + Certificate	3
Third	S$2,000 + Trophy + Certificate	2
Commendation Prizes	S$1,000 + Certificate	1

ATS & SSEF Awards Ceremony (24 April 2019)

- **ALL SSEF Award Winners** will be invited (Junior Scientists, Merit, Bronze, Silver, Gold and INTEL ISEF Awards).
- ATS Winners will be announced
- Parents, Teachers, Principals will be invited.
- GOH - Prof Kurt Wuthrich (Nobel Prize Winner, Chemistry 2002)

- MARK THE DATE!

POSTER DESIGN AND PRESENTATION

(WHAT TO DO AND WHAT NOT TO DO)

By Mr Wong Yih Check

Why SSEF?
Why communicate science?

"I have done some good work and I would like to share my results with others."

Science Communication
– to share scientific findings with others

- through papers / talks / conferences and conventions
- sparks off more ideas and inspiration
- benefits society

Part 1: Poster Tips

Poster

- Reflect only the research done in 2018
- Focused
  - Be concise and clear about the message for the reader
- Organised
  - Follow a logical sequence
  - Have clear headings
  - Let the graphs / images tell the story effectively
  - Use text sparingly – neat and uncluttered
- Easy to read
  - Use **font sizes** (min 24?) that can be read from at least 1 m away
  - Have sufficient white spaces around your text
  - Avoid fancy fonts like this

Nature Derived Carbon Microsheets as Efficient Electrocatalyst for Energy Storage

NAME

BACKGROUND

PROBLEM

No ideal electrocatalyst for sluggish oxygen reduction reaction (**ORR**) of Zn-air batteries:

$O_2 + 2H_2O + 4e^- \rightarrow 4OH^-$

- **Commercial electrocatalyst Pt/C**
  - ✓ High Activity
  - ✓ Efficient (n=4.0)
  - x Poor Durability
  - x Expensive
- **Transition metal oxides:** suffer from agglomeration and dissolution

Tedious to prepare & environmentally unfriendly

This Research

Initial Focus:

Synthesize a better carbon support

Serendipitous Discovery: Carbonized eggplant (EPC) exhibits ORR activity

Starting material: Eggplant
- Naturally Organic
- Low cost

Methods: Carbonization and Activation
- Simple to produce
- Environmentally friendly

Rechargeable Metal-Air Batteries: Zn-air

Overall Discharge Reaction

$2Zn + O_2 \rightarrow 2ZnO$

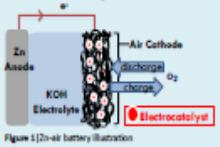
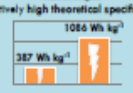


Figure 1 | Zn-air battery illustration

Advantages
- Attractively high theoretical specific energy



*Cheap: Zn is abundant and O_2 is easily obtained from air

Potential applications:
- High energy-consuming electronics: Electric vehicles, etc

OBJECTIVE

Develop an effective metal-free electrocatalyst for Zn-air batteries, using eggplant as the starting material.

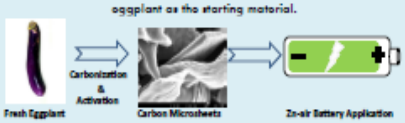
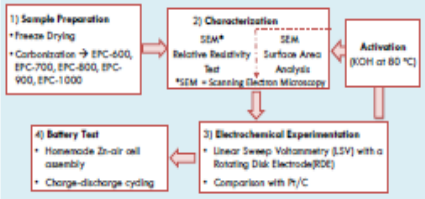


Figure 2 | Scheme illustrating the overview of the flow of work in this project.

METHODOLOGY OVERVIEW



RESULTS

BEFORE ACTIVATION

EPC has sheet-like morphology

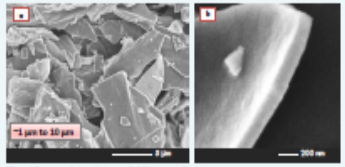


Figure 3 | Low mag. (a) and high mag. (b) SEM images EPC-900.

Relative Resistivity Test

900 °C is an ideal carbonization temperature

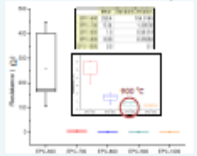


Figure 4 | Relative Resistivity of EPCs. Including a table of the average resistance of each EPC and a zoom-in figure of EPC-700 to EPC-1000.

Electrochemical Experiment

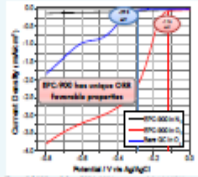


Figure 5 | ORR activity of EPC-900 in saturated 0.1 M KOH at 1600 rpm, highlighting its potential to be an electrocatalyst.

AFTER ACTIVATION

AEPC-900 has similar morphology albeit reduced average sheet size and pores

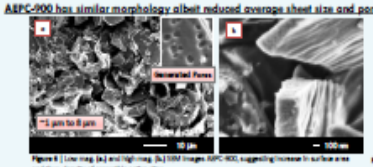


Figure 6 | Low mag. (a) and high mag. (b) SEM images AEPC-900, suggesting increase in surface area and thus, density of accessible active sites.

Electrochemical Experiments

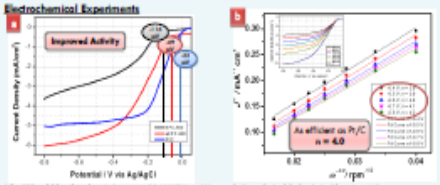


Figure 8 | (a. ORR activities of catalysts in O_2 saturated 0.1 M KOH at 1600 rpm. b. Koutecky-Levich plot derived from linear voltammograms.

Surface Area Analysis

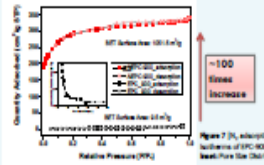


Figure 7 | N_2 adsorption-desorption isotherms of EPC-900 and AEPC-900. Inset: Pore Size Distribution

Battery Test: Stability of AEPC-900 for exceeds commercialized Pt/C

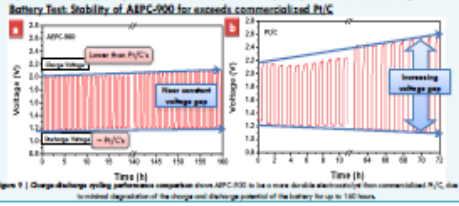


Figure 9 | Charge-discharge cycling performance comparison shows AEPC-900 to be a more durable electrocatalyst than commercialized Pt/C, due to minimal degradation of the charge and discharge potential of the battery for up to 160 hours.

CONCLUSION

AEPC-900 is a promising metal-free electrocatalyst for Zn-air batteries
- **Natural Material**
- **Simple to produce**
- **Low cost**
- **Environmentally Friendly**

AEPC-900 is as efficient an electrocatalyst as commercialized Pt/C; it also offers a comparable discharge voltage, lower charge voltage and superior cycling ability.

The development of Zn-air batteries for high energy-consuming electronics application is advanced

FUTURE WORK

1. Further characterize AEPC-900
2. Study potential Oxygen Evolution Reaction (OER) activity of AEPC-900
3. Explore the possibility of using AEPC-900 in Li-air batteries

REFERENCES

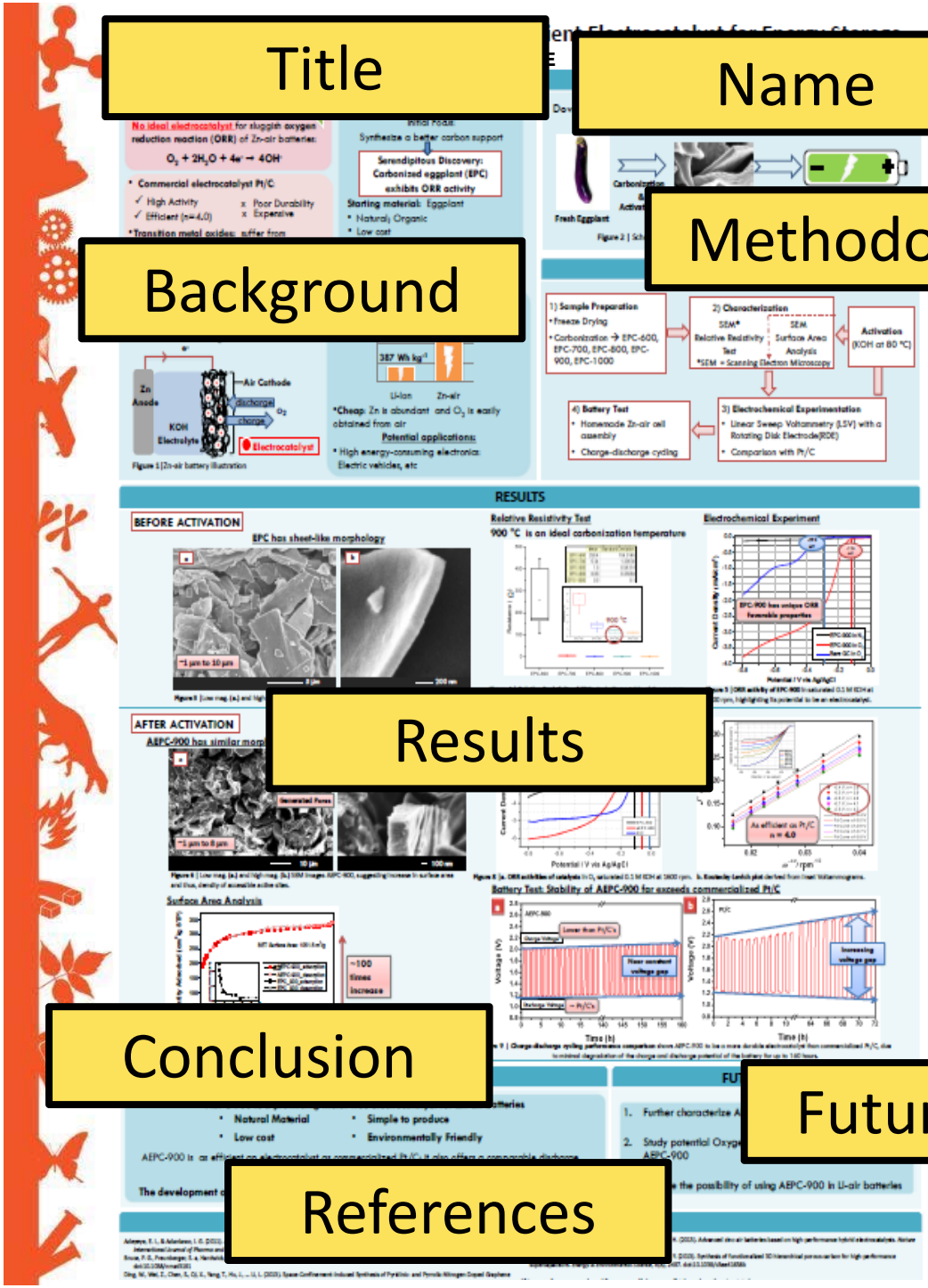
Adeneye, T. L. & Adeniran, I. O. (2011). AMINO ACID COMPOSITION OF THE RIPE FRUITS OF SOLANUM AETHIOPICUM AND SOLANUM MACROCARPON. International Journal of Pharma and Bio Sciences, 2(2), 50–61.

Bruce, P. G., Freunberger, S. A., Hardwick, L. J., & Tarascon, J.-M. (2012). Li-O2 and Li-S batteries with high energy storage. Nature materials, 11(1), 19–29. doi:10.1038/nmat3191

Ding, W., Wei, Z., Chen, S., Qi, X., Yang, T., Hu, J., … Li, L. (2013). Space-Confinement-Induced Synthesis of Pyridinic- and Pyrrolic-Nitrogen-Doped Graphene

Li, Y., Gong, M., Liang, Y., Feng, J., Kim, J.-B., Wang, H., … Dai, H. (2013). Advanced zinc-air batteries based on high-performance hybrid electrocatalysts. Nature Communications, 4. 1805. doi:10.1038/ncomms2812

Qin, J., Chen, W., Xu, H., Xiong, K., Jiang, Y., Zou, R., … Huang, Y. (2015). Synthesis of functionalized 3D hierarchical porous carbon for high-performance supercapacitors. Energy & Environmental Science, 8(8), 2407. doi:10.1039/c5ee01858b



Typical Sections in a Poster

Title

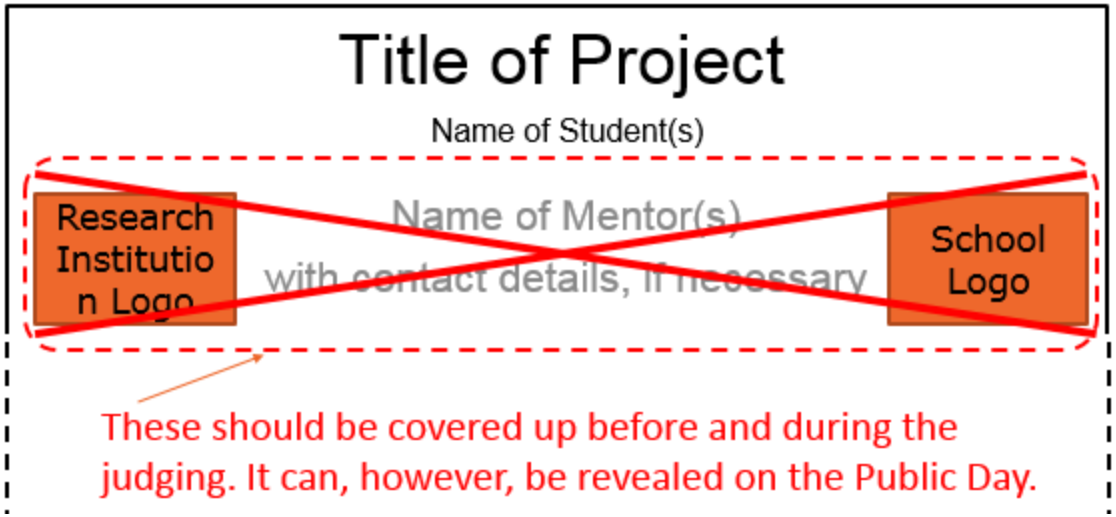
Nature Derived Carbon Microsheets as Efficient Electrocatalysts for Energy Storage

Immobilisation of Glycans on Silicon Substrates for Diagnostic Microarrays

- Clear and Concise
- Use simple words
- Describe the project clearly

Title

- **Title** of your project should be **clearly displayed**
- Any reference to an institution or mentor that supported your research should be covered during the judging process.

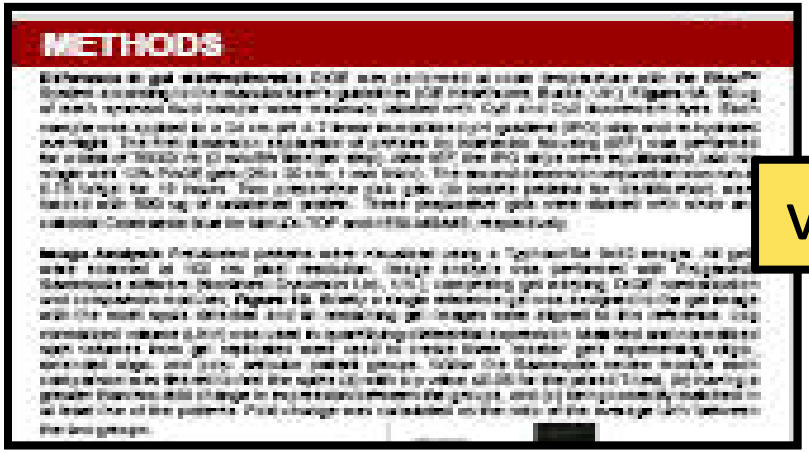


- For **H3 projects**, no references to H3 examination allowed (examination labels, candidate index, title of H3 programme and examining agency must be removed)

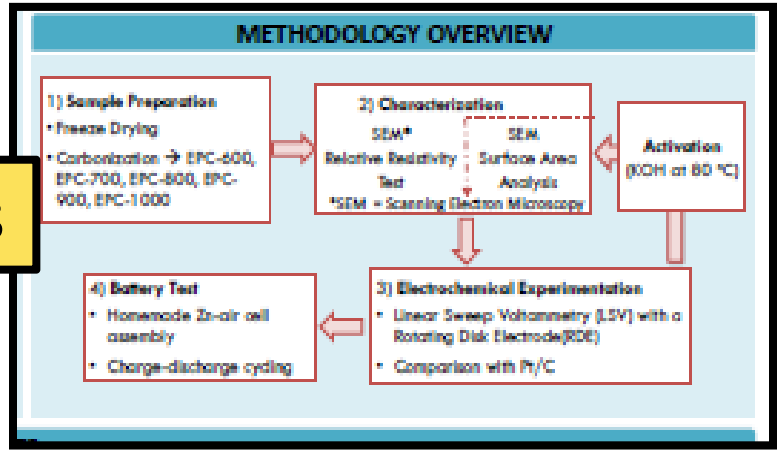
Background/Objective

- Must be included! Provide a context as to why you are doing this project

Methodology



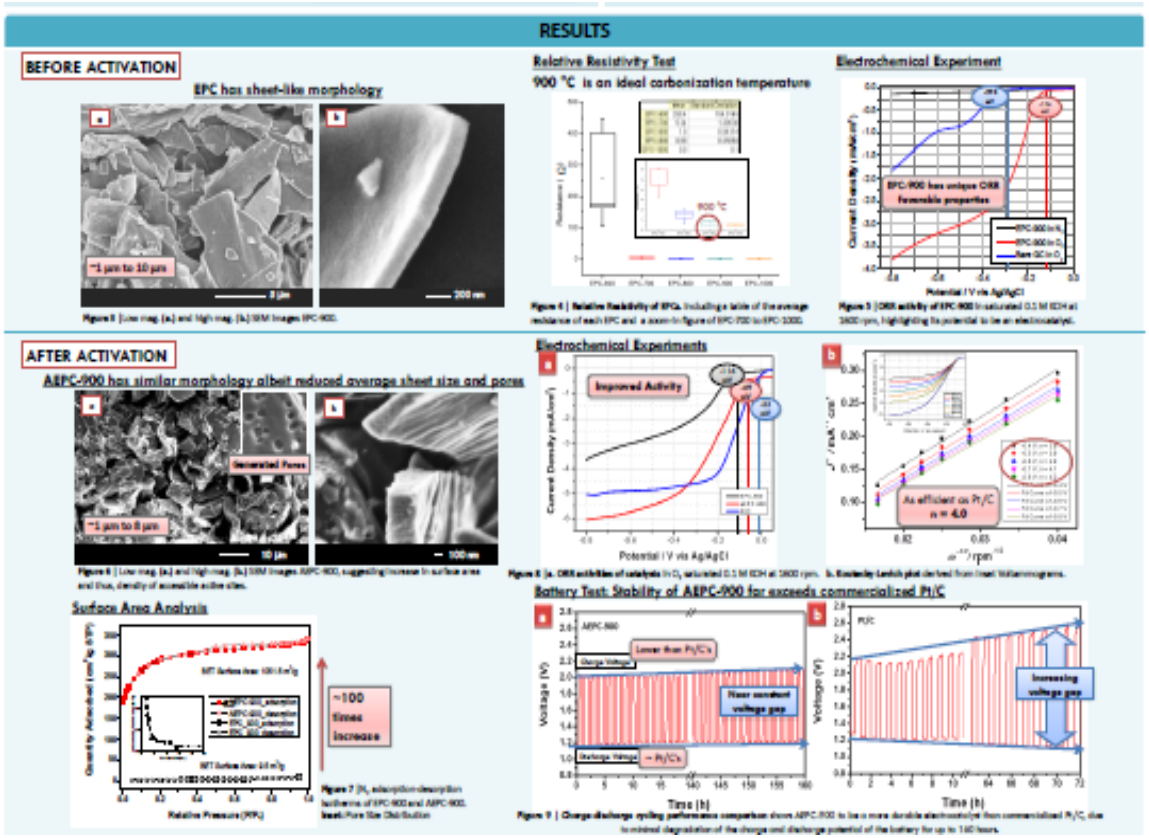
VS



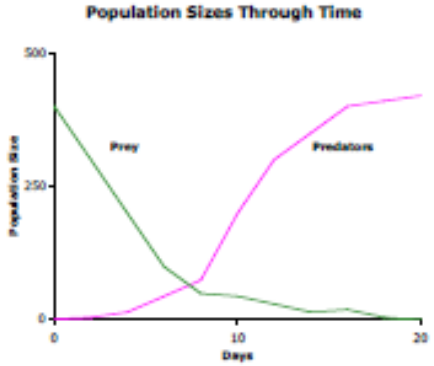
- Briefly describe what you did
- Use figures and flow charts instead of words

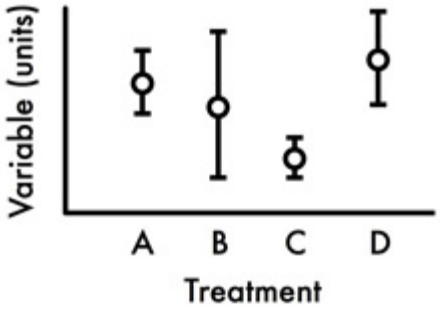
Results

- Most important part of your poster
- Should occupy **prime location** in your poster
- Present data in a **logical** order



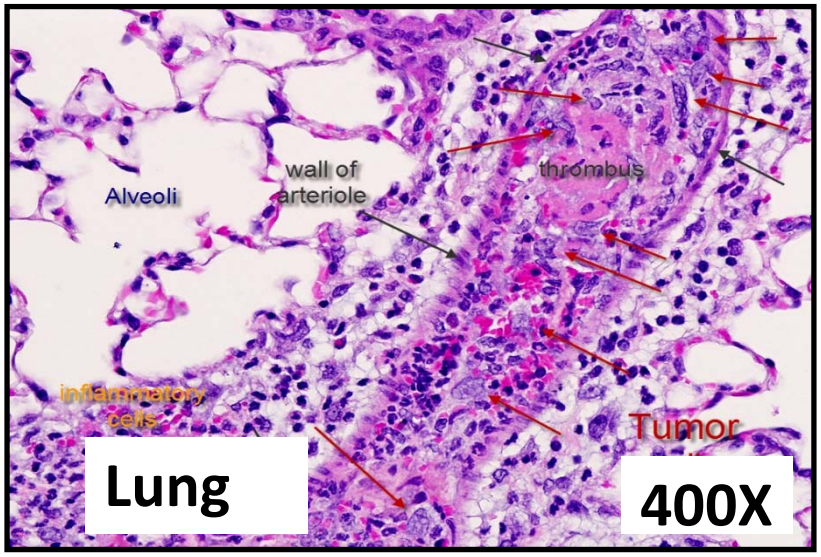
Graphs / Tables

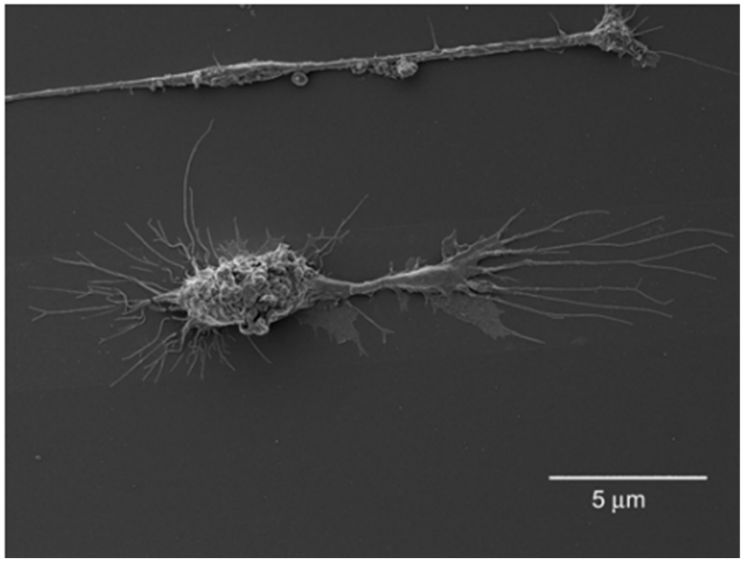




- Context of project will determine how data is presented
- Label axes / Headers with units, etc
- **Interpretation of the data >>> raw data**
- **Relationships / trends >>> exact values**
- Detailed grid lines, markers on axes can be omitted
- Show variations using line plots

Images

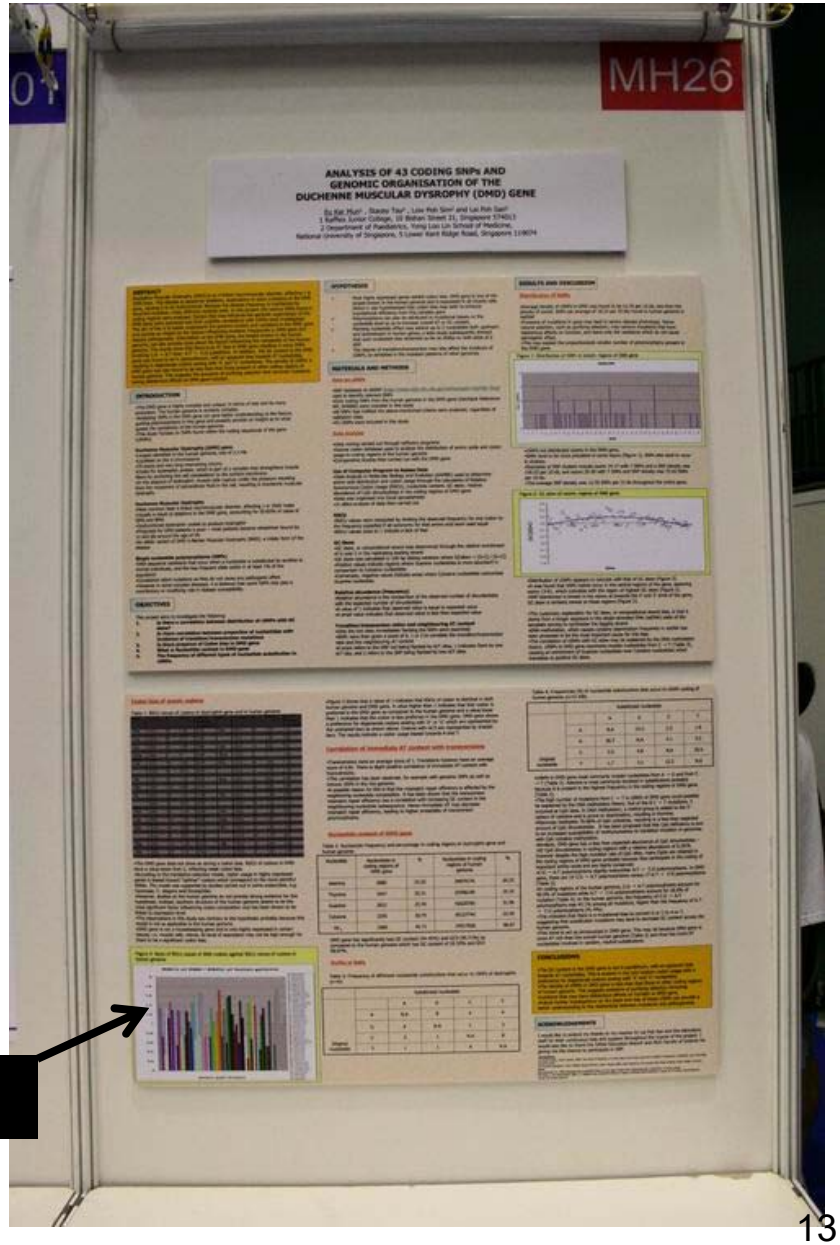




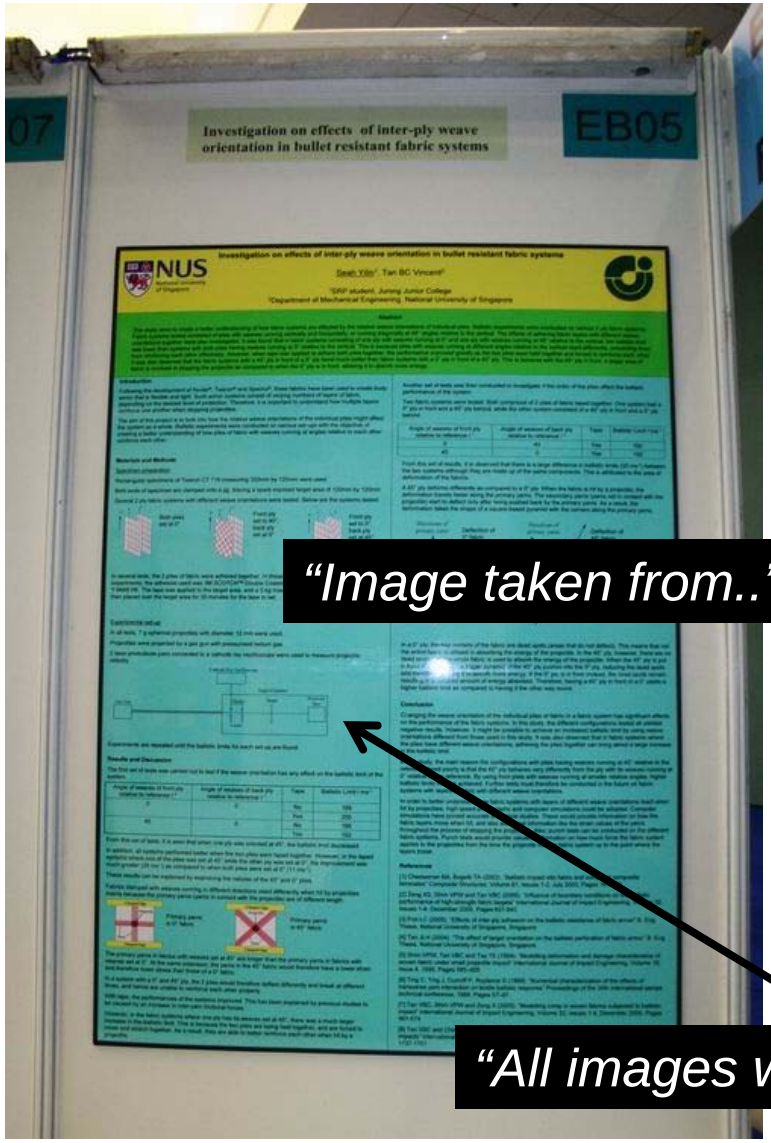
- Should be clear and well labelled
- Contrast
- Microscopic images should have scale bars or magnification stated

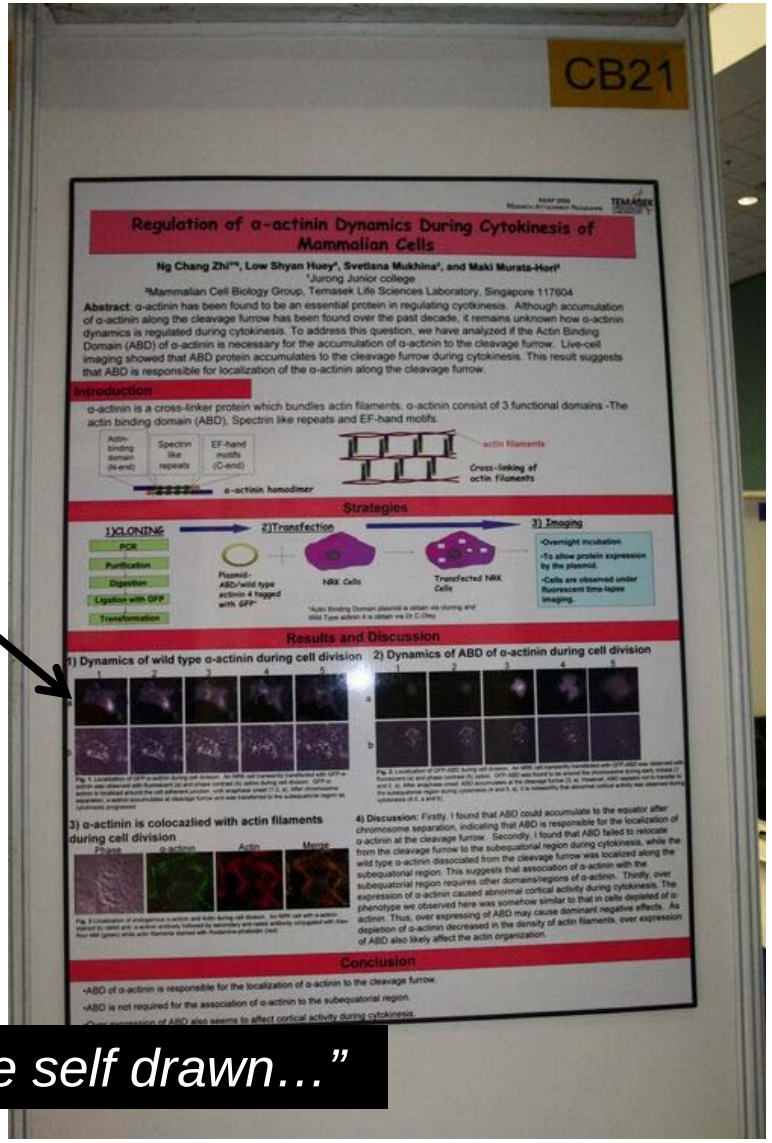
Images

- All images, graphs, photos must be acknowledged. e.g. **“photograph taken by…”** , **“all photographs were self-taken”** or **“Image taken from…”**, **“graph was self-drawn…”**



“Graph was self drawn”



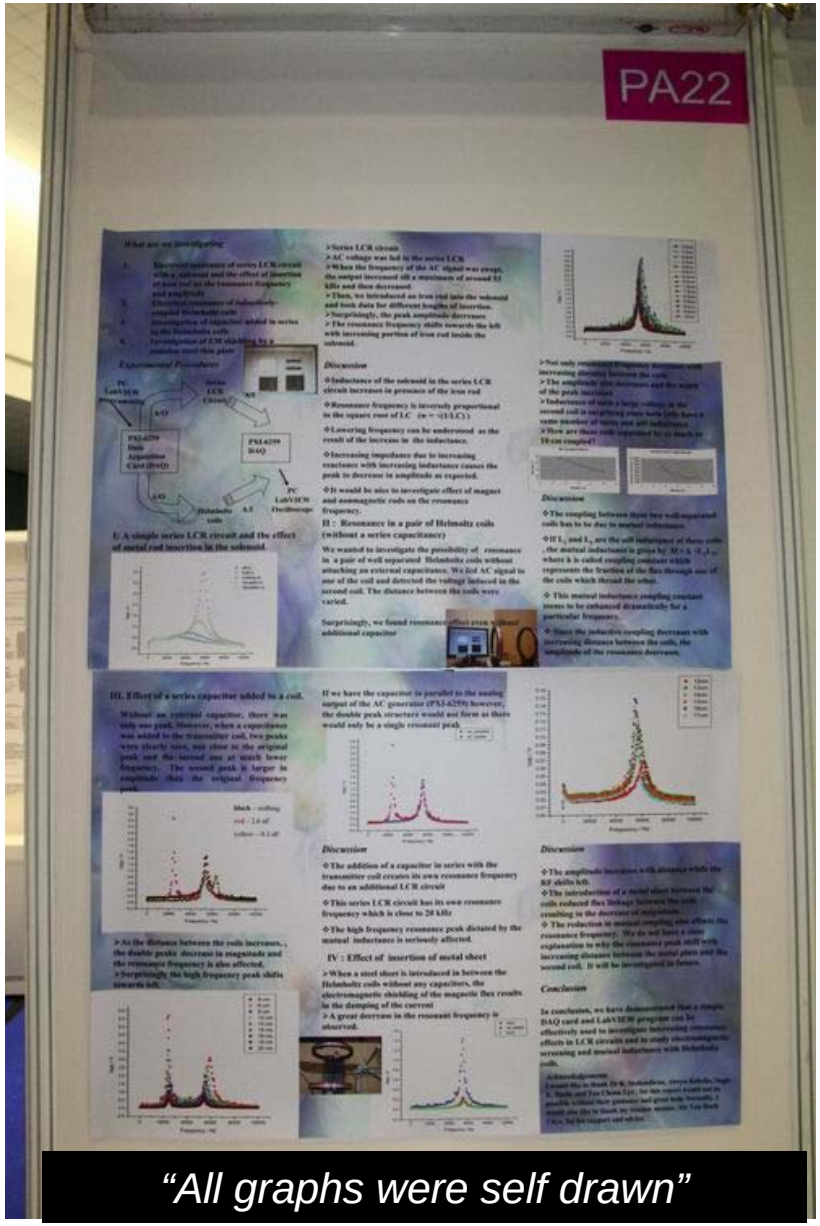


"Image taken from.."

"All images were self drawn…"

Images

- If all images, etc. being displayed were taken or created by the finalist or are from the same source, one credit line prominently displayed on the poster is sufficient.



"All graphs were self drawn"

Before

Introduction

Problem

Industrial wastewater has organic compounds that are toxic [1].
These pollutants are hard to remove by cheap conventional means, e.g. biodegradation with bacteria.

Current solutions

Advanced Oxidation Processes (AOPs) are safe and effective processes, that rely on generation of •OH to break down organic pollutants into CO_2, H_2O and inorganic ions [2].
Electrochemical AOPs (EAOPs) are a subset of AOPs that can continuously generate •OH radicals in-situ using electricity. EAOPs include the photo-electro-Fenton process and in-situ generation of H_2O_2.

Objectives and Hypothesis

Objectives

We aim to design a reactor that can serve as a miniature prototype for a wastewater treatment facility. The reactor will use transparent electrode materials like fluorine-doped tin oxide (FTO), graphene or indium-doped tin oxide (ITO) on glass.

The reactor will be able to utilize multiple EAOPs in tandem, as shown in Fig. 1.

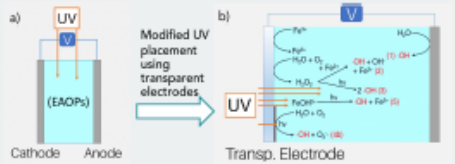


Figure 1: Comparison of (a) conventional UV placement to (b) modified UV placement

Hypotheses

1. The transparent electrode will allow us to place the UV source like in Fig. 1b) such that UV dependent processes will be more efficient.
2. We can make our reactor "greener" by creating and utilizing a parabolic reflector to collect and focus light into the reactor.
3. By using multiple EAOPs together, we can attain a greater rate of pollutant degradation.

Materials and Methods

Transparent electrode selection
Tested: FTO, ITO, graphene as anode and cathode
Compared •OH/H_2O_2 production and stability at pH 3

Transmittance
Verify that FTO on glass allows enough UV light to pass through for UV dependent processes

Cathode selection
Tested: Carbon felt, carbon cloth and a graphite block
Compared H_2O_2 production at pH 3

Phenol degradation
To test the electrodes' selected under beaker conditions
Conditions Varied: Fenton catalyst and UV light
Carbon felt was used as cathode while (i) Boron doped diamond (BDD), (ii) FTO on glass and (iii) platinum (Pt) control were respectively used as anodes

Conclusion and Future works

- Explored suitability of transparent electrodes for wastewater treatment
- Established relative efficiency ranking of EAOPs
- Designed a miniature reactor than can use 2 EAOPs in combination, as well as utilize sunlight

Future works

1. Design of a parabolic mirror to capture and reflect sunlight into the reactor
2. Investigation of TiO_2 coating
3. Optimization of flow-rate, current density and Fenton-catalyst concentration

Preliminary Testing

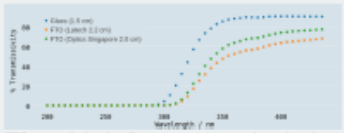
Stability

	ITO	FTO	Graphene-Monolayer
Cathode	Reduced	Reduced	Nonconductive after use
Anode	Damaged by •OH radical [3]	Stable	-NIL-

Table 1: Transparent electrode stability

FTO chosen as transparent anode for use in reactor, as it is the only stable electrode. FTO also generates •OH radicals and some H_2O_2 when used as an anode.

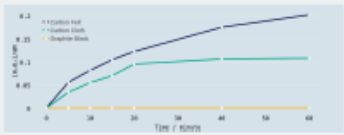
Transmittance



Graph 1: Plot of transmissivity (%) against wavelength (nm)

FTO coated glass has lower transmittance than glass, but still has sufficient % transmittance at UVA region (320 to 400 nm).

Cathode Selection



Graph 2: Plot of $[H_2O_2]$/mM against time/min

Carbon Felt was chosen as cathode for the reactor, since it produces the most H_2O_2 in the same period of time.

Degradation

Process efficiency: UV Fenton > Dark Fenton > UV > Dark

UV photolyses H_2O_2 to give •OH. Fenton catalyses •OH formation from H_2O_2. UV with Fenton accelerates catalytic process.

Anode efficiency: BDD > FTO > Pt

Boron-doped Diamond (BDD) was compared as it is a popular O_2 overpotential anode in literature. Both BDD and FTO have high O_2 overpotential, thus produces •OH radicals through anodic oxidation.
Note: Both BDD & Pt are expensive and opaque electrodes.

Reactor Design

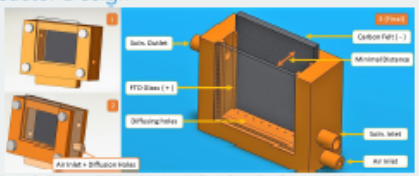
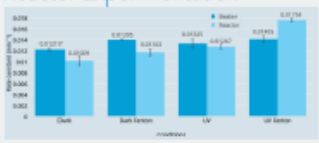


Figure 2: (1) Initial (2) With air holes (3) Final Open Top Reactor, with diffusion inlet.

O_2 Saturated Solution + Maximise Electrode Surface Area + Solar Energy Use = Effective Reactor

Reactor Experimentation



Graph 3: Comparison of kinetic rate constants for phenol degradation in the reactor and beaker, given pseudo-first order model

Process efficiency: UV Fenton > UV > Fenton > Dark

UV Fenton in reactor degrades phenol faster than that in beaker. UV Fenton offers **74%** improvement over dark as compared 15% that in beaker

References

[1] R.Perry, J.N. Lester, N.D. Bedding, A.E. McIntyre. Organic contaminants in the aquatic environment I. sources and occurrence. Science of The Total Environment,25(2):143-167, Oct. 1982.
[2] Marc Pera-Titus, Verónica García-Molinos, Miguel A.Baños, Jaime Giménez, Santiago Esplugas. Degradation of chlorophenols by means of advanced oxidation processes: a general review. Applied Catalysis B: Environmental, 47(4):219-256, Feb. 2004.
[3] M. Froment, J.Bruneaux, G. Folcher, H. Cachet. Anodic corrosion of indium tin oxide films induced by the electrochemical oxidation of chlorides. Thin Solid Films, 301:242-248, 1997.

All diagrams and graphs were self made

After

INTRODUCTION

Industrial wastewater contains organic compounds that are toxic, and some of them cannot be degraded via conventional means, such as biodegradation.

Current Solution: Electrochemical Advanced Oxidation Processes (EAOPs) generate the •OH radical continuously in situ to degrade pollutants. Some EAOPs can be aided by UV light for better degradation.

Problem: Constraints in reactor design make **effective use of UV light difficult to achieve**, and thus UV is not often used in wastewater treatment.

CONCEPTUAL DESIGN

Objective

Using transparent electrode(s) to design a reactor that makes effective use of UV light, and serves as a miniature prototype for a wastewater treatment facility.

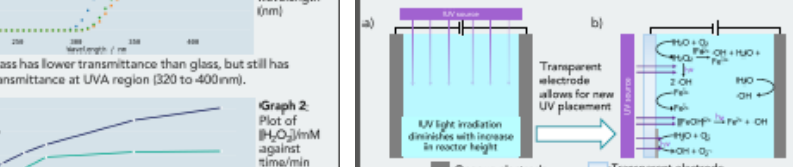
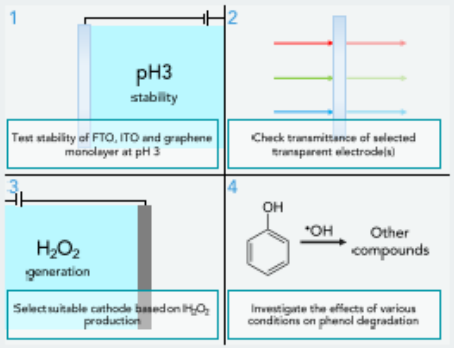


Figure 1: (a) conventional UV placement, (b) modified UV placement

Using a transparent electrode confers two benefits:
1. Direct irradiance on electrodes
2. Minimize loss of UV light as it travels through water

New geometrical possibility due to transparent electrode → Reactor design that **increases efficiency** of UV mediated EAOPs → **Cost effective** and **eco-friendly** due to efficient use of solar/UV light

METHODOLOGY



FTO: Fluorine-doped Tin Oxide, ITO: Indium-doped Tin Oxide

PRELIMINARY TESTING

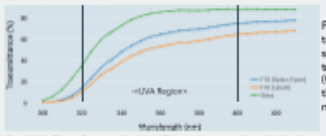
STABILITY

Table 1: Transparent electrode stability

	ITO	FTO	GRAPHENE-MONOLAYER
CATHODE	Metallic coating	Metallic coating	Nonconductive after use
ANODE	Damaged	Stable	-NIL-

- **FTO chosen as transparent anode** for use in reactor, as it is the only stable electrode. FTO also generates •OH radicals and some H_2O_2 when used as an anode.
- Both ITO and FTO most probably reduced as cathode
- ITO most probably damaged by •OH radical as anode [1]

TRANSMITTANCE



Graph 1: Plot of transmittance (%) against wavelength (nm)

FTO coated glass has lower transmittance than glass, but still has a maximum transmittance of 74% (Optics) / 63.7% (Latech) in the UVA region (320 to 400 nm).

CATHODE SELECTION

Graph 2: Plot of H_2O_2 production (mM) against time (min)

Carbon Felt was chosen as cathode for the reactor, since it produces the most H_2O_2 in the same period of time (0.201 mM in an hour).

REACTOR DESIGN

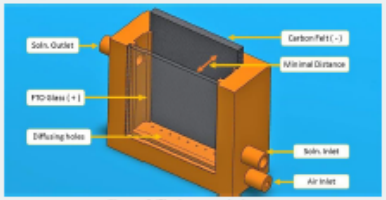
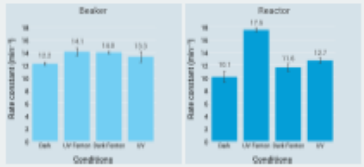


Figure 2: Final reactor design

High Oxygen Infusion + Maximal Electrode Surface Area + Optimal Light Use = Effective Reactor

REACTOR VALIDATION



Beaker setup follows figure 1(a), but with the UV source facing the carbon felt cathode.

Graph 3: Comparison of kinetic rate constants for phenol degradation

Process efficiency (beaker): UV Fenton > **Dark Fenton > UV** > Dark
Process efficiency (reactor): UV Fenton > **UV > Dark Fenton** > Dark

UV Fenton in reactor degrades phenol faster than that in beaker. UV Fenton offers **74%** improvement over dark in reactor as compared **15%** that in beaker.
UV photolyses H_2O_2 to give •OH. Fenton catalyses •OH formation from H_2O_2. UV Fenton accelerates catalytic process.

CONCLUSION

- Explored suitability of transparent electrodes for wastewater treatment
- Designed a miniature reactor that can utilize sunlight well

FUTURE WORK

- Field testing of designed aluminium parabolic mirror with reactor
- TiO_2 coating on transparent electrode.
- Optimization of reactor operating conditions
- TOC: Analysis of total organic carbon to quantify time and energy savings

References
[1] M. Froment, J. Bruneaux, G. Folcher, H. Cachet. Anodic corrosion of indium tin oxide films induced by the electrochemical oxidation of chlorides. Thin Solid Films, 301:242-248, 1997.

Icons made by Freepik and SimpleIcon from www.flaticon.com
All diagrams and graphs were self made

Part 2: Presentation Tips

Profile of Judges

- Scientists / Engineers / Academics
- May or may not have a PhD, but definitely has some knowledge in the field of your project
- Limited specific knowledge of your area of research

Presentation panic?

The judge is not there to

- find fault with your work
- fail you / eat you up

Instead, the judge is there to

- **Understand** your work better
- Ask questions about your work
- **Assess** whether you understand what was done
- Provide **advice** for improvements

What you can control ☺

- Be **on time**
- Be **well prepared** (know your project inside out!)
- Appearance: **Neat, tidy**
- Body language: Be calm, make **eye contact**, **smile** ☺

- Prepare a **short** presentation of your work
  - Introduction (0.5 min)
  - Main Results – **unique selling points** (1.5 min)
  - Conclusion (1 min)
- **Point** to relevant sections of your poster when presenting

Good communication principles

Explain **simply**

- What did you do?
- Why did you do it?
- Why is it important?
- How can it be used?

Prepare well!

(If you can't explain it simply, you probably don't understand it well enough)

Q&A

- **Listen** carefully to the questions
- **Think** about your answers
- **Clarify (or paraphrase)** if you do not understand the question

- **You know your work best, but it's okay to not know everything**

Reference Websites

- Tips for Poster Design:
  - https://sites01.lsu.edu/wp/discover/students/research-aids/creatingposters/
  - https://library.mtroyal.ca/c.php?g=436471&p=2975480
  - https://www.uvm.edu/four/tips-tricks-poster-presentations-0
  - https://projects.ncsu.edu/project/posters/

- Tips for Poster Presentation:
  - https://sites01.lsu.edu/wp/discover/students/research-aids/poster-presentation-tips/
  - https://www.scientifica.uk.com/neurowire/tips-for-presenting-your-scientific-poster-at-a-conference