

STUDENT (and supervisor) GUIDE FOR ES4002 FINAL YEAR PROJECT

The ES4002 provides valuable opportunity to get involve in a scientific research and experience the routine of a research group.

Undergraduate research experiences such FYP are essential for you to gain skills applicable to many jobs and prepare for graduate level programs. This opportunity might help you also to decide which career path at this point you would like to pursue.

From DEI point of view, this [guide](#) written by undergraduate/graduate students in ecology to students applying to undergraduate research experiences tackles the three common sources of anxiety for undergraduate research experiences: imposter syndrome, communicating with mentors, and safety in fieldwork. The tips and reading suggestions are not only for ecology students. Take a look, think about the issues discussed in the article, talk with your colleagues and research team!

1) ELIGIBILITY

- The minimum requirements to do ES4002 Final Year Project is attained Cumulative Grade Point Average (CGPA) of at least 3.5 and completed 105 Academic Units (AU) in third year.
- Students are not allowed to do FYP concurrently with ES4003 Professional Internship (PI) or ES4005 Overseas Entrepreneurship Programme (OEP)

2) STUDENT WORKLOAD

- Two regular semesters.
- For one semester project, it is mandatory for students to complete all their degree requirements with an outstanding of 1 module:
 - 1-4 AUs of Core, Major PE, or General Education Prescribed Electives (GER-PE)

3) HOW TO APPLY

- Students must look for at least one main supervisor who is the academic staff member and his/her designation is Lecturer, Senior Lecturer, Assistant Professor, Associate Professor or Professor from Asian School of the Environment (ASE).
- Students may select the project in one of the options below:
 - (1) **List of project topics:**

A list of available research projects with short description are made available to students at [this link](#).
 - (2) **External Organisation, other Schools Academic Staff within NTU or other higher learning institution:**

Academic staff within or outside NTU are free to suggest their own project topics. However, it should be noted to staff or organisation that the school is not responsible to observe any confidentiality/sensitivity information of their proposed project. They are strongly encouraged to discuss with students before accessing them according to school FYP assessments.
 - (3) **Student Proposals:**

Students may propose their own project idea, but it is their responsibility to approach an ASE Academic Staff with similar research expertise and relevant knowledge to guide them.

- Once students have an approved project and agreed supervisor(s), please complete and submit the [FYP Registration form](#) by the end of first week of Semester.

4) PROJECT ALLOWANCE

The student will be allocated a maximum sum of SGD500 for consumable items depending the disponibility of school funds. Since the funds are limited, ASE Supervisor who **DO NOT** have active research grant to support FYP project will be given priority. Students are advised to check with their supervisor(s) on the available funding.

5) FYP ASSESSMENT AND TIMELINE

For rubrics and the contents of each assessment, please check the course outline.

COMPONENT	WEIGHTAGE	MARKER	TIMELINE
(1) Written Research Proposal (2) Interim report (3) Research Log (4) Demonstration of Laboratory or Field Competence	5% 20% 10% 15%	Academic Supervisor(s)	Please check with Supervisor(s)
(5) Final Written Report and Graphical abstract	30%	Academic Supervisor(s) and FYP Committees	Teaching Week 11
(6) Submission of electronic copy of FYP Full Text Report (final version) via NTU Digital Repository (DR-NTU)	-	FYP Committees	Teaching Week 11
(7) Final Oral Presentation (8) Potential for research	15% 5%	FYP Committees	Reading Week

6) STUDENTS' RESPONSIBILITIES

- Maintain regular discussions with supervisor(s). Be aware that there are different styles of supervision and the best way to a fruitful work is by talking your expectations and needs with your supervisor during the execution of the project.
- It is your responsibility to submit the final version of your report to the [NTU Digital Repository \(DR-NTU\)](#) for archiving **before** submitting your report for evaluation of FYP committee.**

DR-NTU adopts a 4-tiered system to manage access to the work and data deposited:

- Open Access:** Full-text and metadata of works are openly shared and downloadable.
- Restricted Access:** Metadata of works are openly viewable but full-text are shared and downloadable only within the NTU community.
- Embargo:** Authors can delay the sharing of their works by specifying an embargo date (due to pending publication or patent application for example). During the period of embargo (2 years), the full-text will be locked-up but the metadata is created and made publicly viewable. When the embargo expires, the full-text will be viewable and downloadable publicly or to NTU community only (where applicable).
- Exemption:** Authors do not need to deposit their works into DR-NTU

Before depositing your work at DR-NTU, discuss with your advisor which access category you should consider. For more details on embargo and exemption policies for DR-NTU can be found [here](#).

The procedure for submitting your work to DR-NTU is as follows (for more details on submission steps, please refer to the FYP [submission guide](#)):

1. Go to the [NTU Digital Repository site](#).
2. Click on Login, and log in using your NTU Student Authentication. Do not use your full email address (omit the “@e.ntu.edu.sg” part), and do not specify an NTU domain name (omit “STUDENT”).
3. Click on “Start a New Submission”.
4. Select “ASE Student Report (FYP/IA/PA/PI)”, and follow the on-screen instructions.

For any problem or question, please contact NTU library on the email library@ntu.edu.sg.

E) SUPERVISORS' RESPONSIBILITIES

A supervisor will play the role as a guide/mentor, source of information and facilitator to the student as they move through the research project. **There is a spectrum of supervisory styles which can range from “laissez-faire” to more managerial to supportive.**

You are free to adopt different approaches to supervision depending on your own preferences, background, the individual relationship with the student and the stage the student is at in the project. There is no one style fits all and approaches can change and adapt to the student and the stage of the project. To ensure a smooth and fruitful supervision process, set your expectations with the student from the very beginning and re-visit them periodically.

Some general supervisor's responsibilities **could** include help the student to:

- formulate their research project and methods of research to use, and documentation of their research
- become familiar with the research community and language in their chosen field
- ensure their work (e.g. documentation, research integrity, etc) meets the necessary standards expected by NTU
- overcome any problems they might have
- present their work to other students and academics
- prepare for the next steps in their career

F) CHANGE OF SUPERVISOR

It is possible that some time, the academic supervisor is unable to carry out their duties to advise and guide the students as they are on extended leave or has resigned/retired from the University. In such instances, the current supervisor must ensure alternate supervision arrangements are made.

G) WITHDRAW FROM FYP

- Students who wish to discontinue or withdraw from FYP, they should first discuss with their supervisor or seek academic advice from FYP Coordinator. Thereafter, students can request

to drop FYP by indicating reasons for discontinuation in the withdrawal form by Week 13 of the semester.

- Do note that the module will only be dropped next semester. The FYP grade for current semester will reflect as “In Progress (IP)” grade in their degree audit and it is not counted toward their CGPA.

H) STUDENT FEEDBACK

The school welcomes student feedback on how to improve FYP module. Please complete this online form after you submitted electronic copy of your FYP report to DR-NTU.

I) GUIDELINES FOR RESEARCH PROPOSAL

The research proposal should be delivered to your supervisor around weeks *2-3/**4-5 (*1 semester FYP and a **2 semester FYP). This document will be part of your assessment (rubrics are provided in the course outline). Here you will have a great opportunity to discuss with your supervisor the best way to structure your project and to reflect on the steps you want to pursue.

The proposal should be no longer than **1,000 words (~2 pages)**.

The structure below is only a suggestion and it can be adapted.

There are open tools, such as <https://www.cos.io/products/osf>, that you can use to share your research proposal with your supervisor and research team. Make use of them!

A) Provisional Title

The title of your proposal should be short, accurate, and clear. It might change over the development of your research.

B) Research Questions/Contributions

Start by introductory paragraph, give the reader a general sense of the field, the problem or idea your work will address.

State clearly the points you will be addressing during the project and the hypothesis if applicable.

C) Data

Existing Data/Explanation of existing data

Data collection procedures

Sample size

Sample size rationale

D) Analysis plan

Manipulated variables: variables to be manipulated, example light intensity and regime.

Measured variables: variable to be measured during the study. For example, nutrients, temperature, fluxes, cell density, etc.

Indices: for example, from simulated datasets

Statistical models

Inference criteria

Transformations

Data exclusion

Exploratory analysis

E) Study design

Start by defining what type of study you plan to conduct. Below

Study Type

1. **Exploratory research:** Explores the phenomenon and research questions. It is often used to explore new problem areas offering and creating hypothesis that will be explored in the future in causal or hypothesis driven studies.
2. **Descriptive Research:** Descriptive research focuses on shedding light on specific issues through the process of data collection and describing, explaining and validating research findings.
3. **Causal Research:** Explanatory research or causal research aims to understand the impact of certain changes in existing standard procedures or process by conducting experiments.

F) Code Documentation

Add the steps you will use for documenting code and analysis flow you intend to use for your project.

G) Other

Other

I) GUIDELINES FOR INTERIM REPORT

Around weeks 7-12 (1 semester FYP and a 2 semester FYP), thus halfway through your project, you should provide your advisor with an Interim report.

The interim report is the foundation of your FYP report. It should have two parts: 1) a draft of your FYP report introduction and therefore the background information related to your project that you have identified and gathered from the relevant literature; 2) an outline of your material/methods.

Through the interim report your advisor will have a chance to assess part of your development on the literature review you have been conducting and how you are documenting your research besides your personal lab book or annotations.

The interim report will help you to structure and put your work in perspective. It is also a great opportunity to receive a feedback and to discuss with your advisor about conflicting or supporting ideas you found in the literature as well as the best way to document the progress of your research.

Remember, the literature review is the backbone of your knowledge which you will use to describe and discuss your results, and your research log is the way others can reproduce your work. Both are the keystones of any scientific work and in a continuous improvement through the project. You are expected to continue looking for relevant literature and improving your research log until the submission of your final report as well as to improve your interim report into your FYP report.

J) GUIDELINES FOR FINAL REPORT FORMAT

The FYP report is the written evidence of the procedures, processes and activities that were performed and accomplished while pursuing the project. A good project report should present your

work in effective concisely manner. The FYP report is written in the format of a scientific publication and therefore it is an opportunity to learn how to document and explain your work at the level that any scientist can understand. The big challenge here is to find a balance between over-explaining and under-explaining.

When writing your report imagine that an undergraduate or graduate student have join the research group and is really excited about the analysis you performed during the FYP, and would like to replicate the analysis with their own data or continue your work.

1. were all methods, databases, and software tools cited and properly described? Have you indicated dates and version numbers of websites that were used to obtain data, code, and other third-party resources?
2. were all data, code, results, and documentation organized within a “hierarchical” folder structure on our computer?
3. Is your lab-protocol and/or analyses routine well documented?

The guidelines below aim to help you to produce a good final year project report with advices on the conventions that could govern the structure of the report. The rest is with you!

LANGUAGE

The report should be written in clear and precise English in third person with free of grammatical, syntactical, and spelling errors. The first person can be used for personal view or any other aspects – it would be advisable to consult supervisor(s) on when it is appropriate to use “I” or “we” in the scientific report.

COLOURS IN SCIENCE

Every STEM field benefit from an accurate representation of data, however, it is not uncommon to find distort data visualization with inaccurate colour gradients or unreadable figures to those with colour-vision deficiency (e.g. colour-blind) in the literature, seminar presentations, etc.

The article by Cramer et al (2020) – “[The misuse of colour in science communication](#)” discuss well this problem and offers a list of tools to tackle this problem. Please take a look and be inclusive when representing your data.

SPECIFIC FORMAT

The general format of the report follows a **research article** where the development and results of a novel research study is presented, discussed. The FYP committee will also accept “**research reviews**”. Research reviews is a comprehensive analysis of a specific topic and it should describe and synthesize recent developments and highlight future directions.

- The report can be divided is **4 numbered sections** (1. Introduction, 2. Material and Methods, 3. Results and Discussion, 4. Conclusion and Future Work for research style reports. Research reviews are exempt of **these** sections), **Appendix** and **References**. It should also contain **Abstract**, **Acknowledgement**, **List of figures**, **List of tables** and **Table of contents**. Please check the templates provided. We are aware different fields of research (i.e. for social science or policy-oriented research) have different formats and therefore the four sections are not set in stone.
- The Word limit is maximum **5000 (includes only the 4 main sections: Introduction; Materials and Methods; Results; Discussion; and Conclusions)** for the report. It **does not include** abstract, significance statement, section headings and subheadings, figure legends, table headings, words used in figures and tables, table footnotes, references and acknowledgement.
- The word limit for abstract is maximum of **250 words**.
- Maximum of **6 medium-size graphical elements** (i.e., figures and tables).

- **Figures are labelled section number – figure number.** For example, figures add at the Material and Methods (section 2), should be label as Fig 2-1, Fig 2-2, etc.
- Page numbers: bottom right corner (more details at **Table of Contents and Pagination**)
- Utilize two-sided printing to reduce paper use.
- Paper size is A4
- Margins: 1 inch left and right; 1 inch top and bottom
- Line spacing:
 - ✓ Text: 1.0 lines for all sections except References.
 - ✓ References: 1.0 lines.
 - ✓ Figure legends, table headings, and table footnotes: 1.0 lines
 - ✓ Table contents: 1.5 lines
- Section headings and subheadings in bold
- Font type: Times New Roman (keep the same font for the entire document)
- Font sizes:
 - ✓ Text and all sections sub-subheadings: 12 point
 - ✓ All sections subheadings:14 point
 - ✓ All sections headings:20
 - ✓ Figure and Table legends: 12 point
 - ✓ Table footnotes: 10 point

ORGANISATION OF THE REPORT

The report should be written as concisely as possible and all figures must be of a quality such that the examiners can evaluated the results. Templates for word have been provided by email and latex template can be found [here](#).

(A) Title Page

The first page of the report includes project title (in capital letters), author's names and student matriculation number (in capital letters), name of supervisor(s), the degree to be awarded at NTU and date of submission.



PROJECT TITLE

NAME OF STUDENT

Matriculation number

Supervisor: Xxxx

Co-supervisor: Xxxx

A Final Year Report submitted to Asian School of the Environment, Nanyang Technological University in partial fulfilment of the requirements for the Degree of

**BACHLOER OF SCIENCE WITH HONOURS IN
ENVIRONMENTAL EARTH SYSTEMS SCIENCE**

2020/2021 Semester 1

(B) Abstract

The abstract gives a brief overview of the report content stating the objective, working methods, main findings, and conclusion. It is usually written in one paragraph of **250 words**. It should also contain the list of key words.

(C) GRAPHICAL ABSTRACT AND SIGNIFICANCE STATEMENT

The graphical abstract is **one single - panel image** that is designed to give readers an immediate understanding of the work developed during the FYP and the main findings. A good graphical abstract should allow readers to quickly gain an understanding of the main take-home message of your work.

The graphical abstract should be **accompanied of a significance statement**. The statement should explain the significance of the research at an understandable level to a non academic audience. Include no more than 100 words.

For students and PI who wish to have their Graphical abstract and significant statement shared and reproduced on ASE website and social media outlets, please check the declaration in ANNEX X.

GENERAL INSTRUCTIONS FOR GRAPHICAL ABSTRACT

- Keep it simple
- Use simple labels
- Use text sparsely and economically
- Avoid distracting and cluttering elements
- Provide a clear start and end, example "reading" from top-to-bottom or left-to-right
- Emphasize the new findings of your work without including excess details from previous literature
- Avoid the inclusion of features that are more speculative (unless the speculative nature can be made apparent visually)
- Avoid data items of any type (e.g. tables and graphics)
- the abstract should consist of one single panel
- Font: Times New Roman, 12 points. Smaller fonts will not be legible online.

(D) Acknowledgement

Acknowledgments should be gathered into one paragraph. The Acknowledgments should recognize non-author contributions (e.g. organisation or others who provide guidance, advice, technical assistance, or facilities your research project) followed by authors contributions (those who would consider to share the authorship of your report). We encourage you to follow the [CRediT](#) taxonomy to define the role each author had in your work.

(E) List of Figures

(F) List of Tables

(G) Table of Contents

Table of Contents lists all the main headings, sub-headings with corresponding page numbers. Pages like abstract, acknowledgements, list of tables and list of Figures should be numbered using lower case Roman numerals while other pages (except title page) should be numbered as Arabic numerals as shown in the example below.

(H) 1. Introduction

Introduction provides background information explaining the theory, processes, aims or hypothesis and rationale for conducting the research project.

The main purpose of this part of your report is to introduce the reader to the area of research, provide relevant background information and put the presented work into context. The review of the literature you will do to build your introduction it will also provide you with the foundation knowledge for the discussion of your results. Remember, you will be also assessed on how you approach and compile the literature during the project.

(I) 2. Materials and methods

Materials and methods **must be written in past tense**. It details the list of materials used, how equipment/apparatus were set up and what was the procedure to carry out the project work. The MM section should have enough information for someone to replicate the work and achieve a similar outcome. This seems a simple task but in reality, it is not.

Most of the scientific journals today impose word limits on manuscripts, like you have for your report. One direct consequence is that MM sections become an infinite loop of citations to previous works that each cite previous work. You can improve your documentation in the appendix (see below) or archives such as [protocols.io](https://www.protocols.io) for lab-based methods or through [GitHub](https://github.com) for data analysis workflows. Both platforms can be open to the public or with restricted access. Discuss previously with your advisor which restrictions you should put in your protocols and data analysis workflow.

For data analysis workflows, software such as [GNU Make](https://www.gnu.org/software/make/) and the [Common Workflow Language](https://www.common-workflow-language.org/) help to track data dependencies and automate a workflow.

The use of literate programming tools such as **RMarkdown** and **version control software** will help you, your advisor, and others to track the development of your analyses. These tools can also help you to reflect on the path you are choosing for analysing your data. Are you falling into the trap of the "[Garden of Many Forking Paths](https://www.gardenofmanyforkingpaths.com/)" or "P-hacking," where large numbers of analyses are attempted in order to find a desired result?

For more information and guidelines to document codes and analyses please check: [Ten simple rules for documenting scientific software](https://www.ten-simple-rules-for-documenting-scientific-software.com/) and [R Code – Best practices](https://www.r-project.org/doc/2015-08/r-markdown2.html). Although we strongly encourage you to use these tools, the FYP committee **do not request access** to your GitHub repository or protocols.io space for example.

(J) 3. Results and Discussion

The core findings of the study should be presented without bias, interpretation, or evaluation. Presented information can include but is not limited to:

- Data presented in tables, charts, graphs, diagrams, either placed amongst explanatory text or on a separate page.
- Make your figures accessible for people with colour-blindness. For more information and source of palettes and codes (R code), please check [here](#).
- Relevant results from any statistical analyses and corresponding explanations of any statistical significance
- Summarise the most important findings.
- Describe the patterns, principles, and relationships within the results.
- Explain how the results relate to the hypothesis or the questions posed in the introduction.
- Explain how the work fits into the existing body of knowledge about this topic.

- Give any suggestions/opinions based on the research findings.
- See [here](#) for a 12-step guide to writing an effective discussion.

(K) 4. Conclusion and Future work

Conclusion summarises what the main findings are, and what they mean. No study is ever perfect. State here which parts of the research process could be improved to yield clearer or more relevant results. Describe the next logical steps for research, given more time or resources, as well as any future hypotheses for this work.

(L) References

Include any textbooks, journals, websites that was used in the report. For articles, only those that have been published or are in press should be listed. Submitted manuscripts or personal communications should be cited within the text only and not listed in the References. For published conference abstracts, patents and research datasets with an assigned a digital object identifier (DOI) should be included in the reference list as well.

“EndNote”, Mendeley or Zotero are common tools used to manage the reference list, format and for inserting references into the text. Software and guides are provided by NTU library [here](#).

References should be cited in accordance with **American Psychological Association (APA)**.

(M) Appendix (if any)

The main text of your report must be **understandable on its own without the material in the appendix**. If you choose to place detailed materials, methods, statistics outputs, etc in the appendix, you still need to provide sufficient detail in the main-text methods to enable a reader to follow the your procedures and results.

When preparing annex files, please keep in mind:

- Refer to the Annex material (e.g. Figure A-1 or Table A-1) in the manuscript at an appropriate point in the text.
- Number supporting figures and tables starting with A1, A2, etc.
- Follow the specific format of the main text for font size, type, margins, etc. **There is no word restriction for the appendix.**

II) GUIDELINES FOR FYP POWERPOINT

12.1 POWERPOINT PRESENTATION

- Students will be given 15 minutes to present their research project and 5minutes to answer questions from panel and audience.
- The presentation should be a general overview of their FYP outlining aims and objectives, introduction, experimental details, a summary of the results and discussion, conclusion as well as what is the achievement/contribution gained at the end of the project.
- Avoid having too much information and texts on one slide. Use bullet point, short sentences, and pictures/figures/graphs where appropriate. Keep to a maximum of 10-15 slides.
- Prior the actual presentation date, students should keep practising and time themselves to ensure that their presentation is within the allocated time slot. DO NOT BE NERVOUS. Speak confidently, clearly, concisely, and professionally before/during the presentation.
- Students may to this webpage on how to give a good presentation:
http://acmg.seas.harvard.edu/education/presentations/carlton_presentations.pdf

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