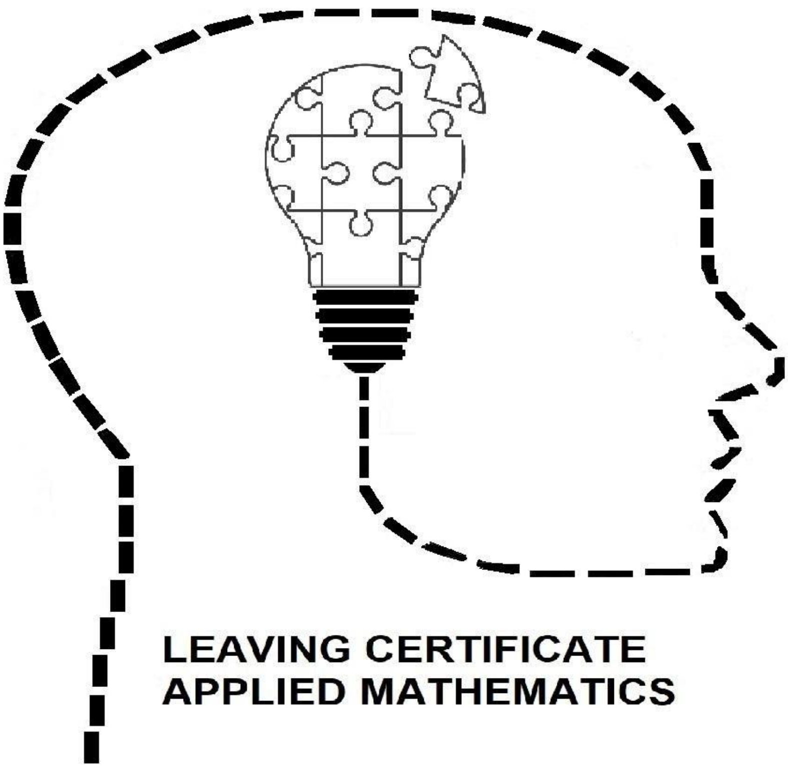
PDST
Professional Development Service for Teachers | An tSeirbhís um Fhorbairt Ghairmiúil do Mhúinteoirí

An Roinn Oideachais
Department of Education



Student Modelling Journal

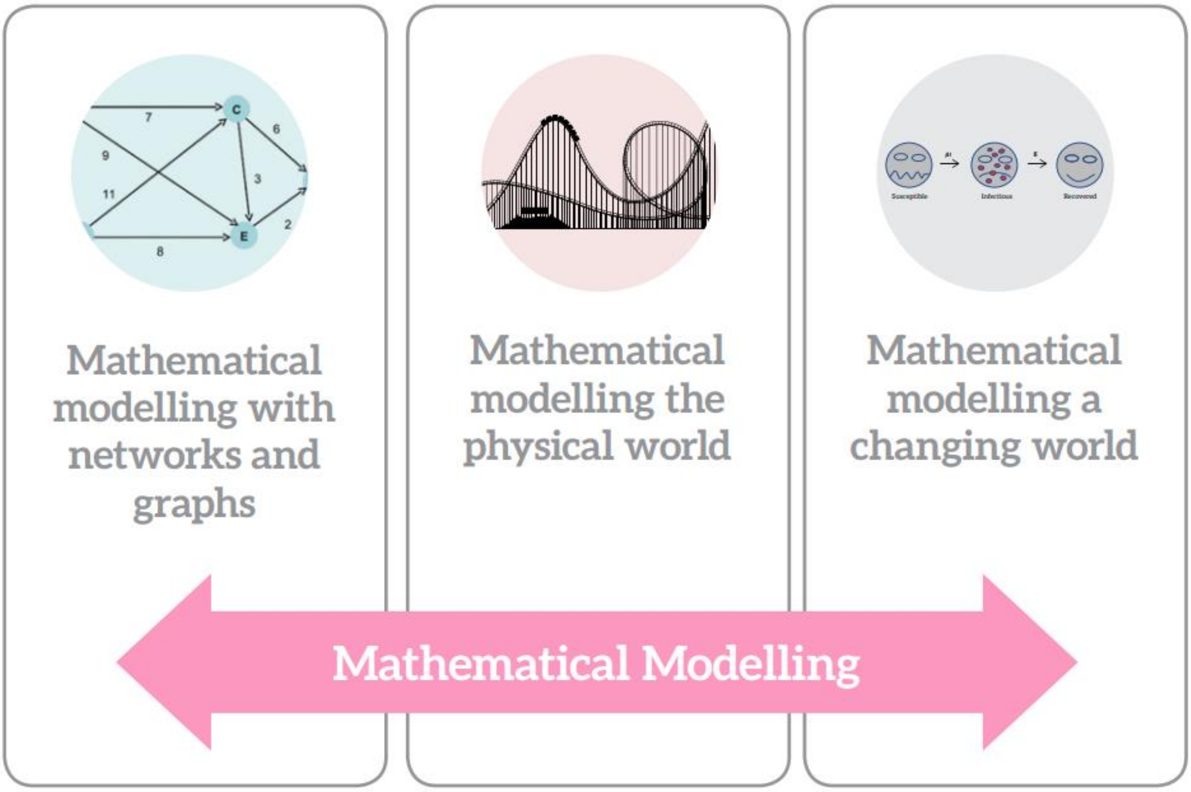
Name:	
Title:	

Introduction

This modelling **journal** is intended as a support for students in developing their mathematical-modelling skills. Mathematical modelling is the unifying strand of the Applied Mathematics specification and underpins all teaching, learning and assessment of the subject.

In 6th year, students will be expected to complete their own modelling project and this will form a key part of assessing their learning in Applied Mathematics. Ongoing engagement with modelling, as part of the daily classroom experience, will support students in preparing for this. The Leaving Certificate modelling project report will be completed in a digital completion booklet which will be provided by the State Exams Commission upon publication of the project brief in 6th year.

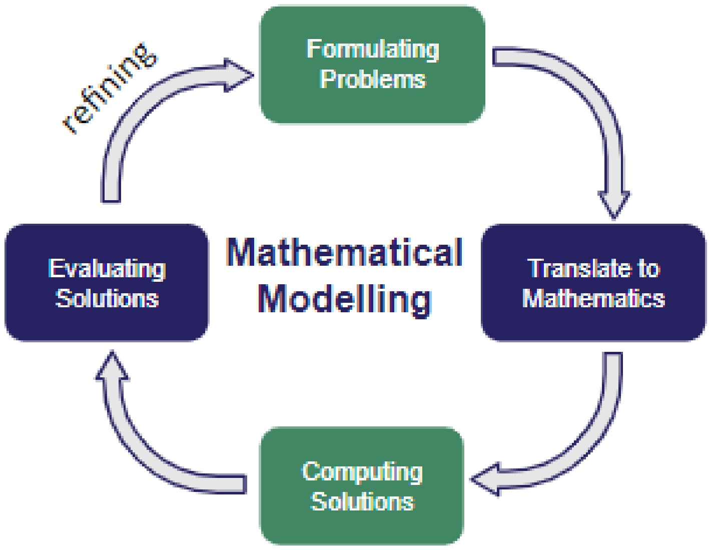
Please note that a certain number of pages is provided for students to complete each stage of the modelling cycle below but if more is needed then feel free to use additional paper.



Source: Leaving Certificate Applied Mathematics Specification

Mathematical Modelling

Mathematical modelling is the use of mathematics to solve open ended real world problems. It involves translating from the real world to mathematics in both directions. Modelling is best learned by doing and the more it is practised, the better you will be at solving modelling problems.



Mathematical modelling involves much more than doing calculations and using equations to determine solutions. Successful modellers are skilled in:

- Using real world situations to formulate/construct a mathematical problem.
- Researching information relevant to solving a problem.
- Making assumptions that will aid in creating a mathematical model and giving reasons why they made those assumptions.
- Understanding that there can be multiple solutions to a modelling problem depending on how a modeller formulated the problem and the assumptions made.
- Choosing a suitable mathematical approach to calculate a solution.
- Identifying how their model can be improved and making refinements to enhance their model.
- Communicating their findings and translating them back from mathematics to the real world.

Leaving Certificate Applied Mathematics Modelling Project

The modelling project assessment will require students to demonstrate proficiency in course content and skills that cannot be easily assessed by the written examination. The assessment will require students to present a solution to an authentic modelling problem, and to report on the work and process involved. Students must acknowledge (i.e. through citation, through attribution, by reference, and/or through acknowledgement in bibliographic entry) the source or author of all information or evidence taken from someone else's work. Student work will be submitted to and marked by the State Examinations Commission (SEC).

Through the modelling project, students are afforded an opportunity to engage in the full modelling cycle to propose a solution to an authentic problem in a real context. The modelling project will assess the student's ability to use mathematics to represent, analyse, make predictions or otherwise provide insight into a real-world phenomenon. The key skills of processing data and information, communicating, critical and creative thinking, being personally effective and working with others can be developed through all the learning in this course, and these skills will be applied through the student's engagement in the modelling project.

The modelling project will be based on a brief issued annually by the State Examinations Commission (SEC). A common brief will be issued for Ordinary level and Higher level. The brief will outline a modelling problem in a real-world scenario. There is no predetermined solution strategy and the students have ownership of all decisions they make as they progress through the modelling cycle to arrive at their solution. The brief will also outline the parameters for the problem and for the format of the report, which will be submitted to the SEC for assessment. The modelling project will be completed in sixth year.
The modelling project requires students to demonstrate that they can:

- define a problem
- translate the problem to mathematics
- compute a solution
- analyse the solution and iterate the process.

The report must be the student's own work. Authentication procedures will be in place to ensure compliance with this requirement. These will include a protocol in relation to the use of internet-sourced material. (Source: Leaving Certificate Applied Mathematics Specification)

The Modelling Project Report

Students are required to present and submit a Modelling Project Report digitally using the template, file format type and instructions specified by the State Examinations Commission (SEC). The completed report will comprise of some or all of the following elements: written text, data tables, diagrams, digital images and photographs

SECTION	INDICATIVE CONTENT
Introduction and Research	‣ Background research on brief including citations and references ‣ Defining the specific problem(s) to be modelled ‣ Research on the specific problem(s) including citations and references ‣ Identification of the relevant variables ‣ Presentation of relevant data
The Modelling Process	‣ Explanation and justification of the model and assumptions ‣ Computation of the solutions ‣ Presentation of solutions using appropriate mathematical and graphical representations ‣ Analysis of solution(s) – sensitivity to changes in assumptions; comparison with other solutions or real-world data ‣ Evidence that the process has been iterated
Interpretation of Results	‣ Interpretation of solution(s) in real-world context ‣ Conclusions and reflections
Communication and Innovation	This is not a distinct section of the report. ‣ Innovative and creative approaches ‣ Quality and clarity of presentation

Overview of the main sections and indicative content that may be included in the report

(Source: Guidance to Support the Completion of the Modelling Project)

Modelling Project Assessment Criteria

THE STUDENT DEMONSTRATING A HIGH LEVEL OF ACHIEVEMENT:	THE STUDENT DEMONSTRATING A MODERATE LEVEL OF ACHIEVEMENT:	THE STUDENT DEMONSTRATING A LOW LEVEL OF ACHIEVEMENT:
states the problem statement concisely, early in the written report. References sources from background research. identifies several variables affecting the model and notes and justifies the need for the main factor that influences the phenomena being modelled. clearly identifies and justifies the assumptions used to develop the model and, where appropriate, states the limitations of the simplification of the problem due to the assumptions made. indicates exactly what the output of the model will be and, if appropriate, identifies the audience and/or perspective of the modeller.	identifies a problem statement which is not precise or consistent with other statements in the report. lists important parameters and variables properly, but without sufficient explanation. notes primary assumptions, but without justification.	presents a problem statement that is difficult to understand or is buried in the text. identifies assumptions and justifies them, but they are difficult to identify in the text. barely mentions variables/ parameters or, if mentioned, they are difficult for the reader to identify in the text.
provides clear insight with logical mathematical reasoning into the mathematical method(s) used to describe the relationship between the variables, and to solve the problem. Presents a plausible approach and outcome.	states a mathematical approach, however with aspects of the method(s) which are inconsistent, difficult to understand or incomplete.	states a model which contains fixable mathematical errors.
clearly presents an accurately-computed solution and analysis of the relationship between variables, supported where appropriate with visual aids and graphic representation that is consistent with the original problem statement.	states an answer, however with aspects of the solution(s) which are inconsistent, difficult to understand or incomplete (e.g. fails to identify units of measure).	states an answer but without contextual background (i.e. appropriate graphics, appropriate units, etc.). arrives at no solution.
addresses the viability and reliability of the mathematical modelling solution. considers how sensitive the model is to changes in parameter values or altered assumptions; how it compares to other solutions or historical data. The model is refined and the process iterated.	addresses the viability and reliability of the mathematical modelling solution, however with analysis which lacks proper dimensionality, e.g. obvious consequences of the stated outcome are ignored or well-known comparisons are disregarded.	provides some analysis but without any sense of perspective. uses incorrect mathematics in the analysis.
presents a paper that is well-formatted and enjoyable to read, with easy to interpret visual aids (if appropriate).	presents a paper with multiple spelling, formatting or grammatical errors, visual aids which are missing key readability features or which do not clearly connect to the solution.	presents a paper with significant disregard for common spelling, grammatical and mathematical rules.

(Source: Leaving Certificate Applied Mathematics Specification)

Mathematical Modelling Self-Assessment Tool

Mathematical Modelling: Self-Assessment Tool

Formulating the Problem:

- What is the problem being asked and what research must you do?
- What variables (factors) are relevant to the problem?
- Can you simplify the problem into smaller manageable parts?
- What assumptions will you make to simplify the problem?
- Consider if there are limitations to your model due to the assumptions you have chosen?
- Can you predict what the output of your model will achieve and for what context (who/what) will be affected by your model?

It is fine for a problem to have more than one solution to it depending on the assumptions chosen.

Translating the Problem to Mathematics:

- What mathematical approach will you use to solve the problem and why?
- Where will your assumptions and variables be used in your model?
- Can you describe the relationship between your variables and your mathematical approach?

Computing the Solution:

- How did you calculate your solution and what effect did your variables and assumptions have on it?
- Did you use computational technology to assist in your calculations? If so, what form did this take?
- How will you present your solution (graphs, charts, etc.)?
- Explain the relationship between your solution and the original problem statement?

Evaluating the Solution:

- Does your answer make sense and have you taken sign, magnitude and units into account?
- How accurate and reliable is your solution based on your earlier assumptions?
- What effect would changing your variables/assumptions have on your solution?
- How does your solution compare with previous solutions/iterations?
- Can you refine/alter your assumptions to improve your solution and will this change your solution much?

Next iteration

It is important to show how your model is improving with each iteration and why you altered your assumptions/approach.

It may be helpful to present your work so that someone unfamiliar to your project will understand it.

Presenting your Final Model:

- How will you present your final paper so that it is well formatted, clear and easy to read?
- Can visual aids be used to better communicate your work?

Thinking About How I am Learning:

It can be useful to think about your own approach to mathematical modelling, what is working well and how you could improve your approach. Making note of what worked well (and maybe what didn't) will make the next modelling problem easier.

Name:	Date:
Title:	
What mathematical skills do I already know that I could use in this task?	
How well is my strategy working? Do I need to change my approach?	
What was easiest/hardest for me in this task? Why?	
What strategy will I try to improve upon for the next time?	

Formulating the Problem:

What is the problem being asked and what research must you do?
What variables (factors) are relevant to the problem?
Can you simplify the problem into smaller manageable parts?
What assumptions will you make to simplify the problem?
Consider if there are limitations to your model due to the assumptions you have chosen?
Can you predict what the output of your model will achieve and for what context (who/what) will be affected by your model?

Description:	**Date:**

Translating the Problem to Mathematics:

What mathematical approach will you use to solve the problem and why?
Where will your assumptions and variables be used in your model?
Can you describe the relationship between your variables and your mathematical approach?

Description:	**Date:**

Computing the Solution:

How did you calculate your solution and what effect did your variables and assumptions have on it?

Did you use computational technology to assist in your calculations? If so, what form did this take?

How will you present your solution (graphs, charts, etc.)?

Explain the relationship between your solution and the original problem statement?

Description:	**Date:**

Evaluating the Solution:

Does your answer make sense and have you taken sign, magnitude and units into account?
How accurate and reliable is your solution based on your earlier assumptions?
What effect would changing your variables/assumptions have on your solution?
How does your solution compare with previous solutions/iterations?
Can you refine/alter your assumptions to improve your solution and will this change your solution much?

Description:	**Date:**

Presenting your Final Model:

How will you present your final paper so that it is well formatted, clear and easy to read? Can visual aids be used to better communicate your work?

Description:	**Date:**

Recording Ideas/Notes During Modelling:

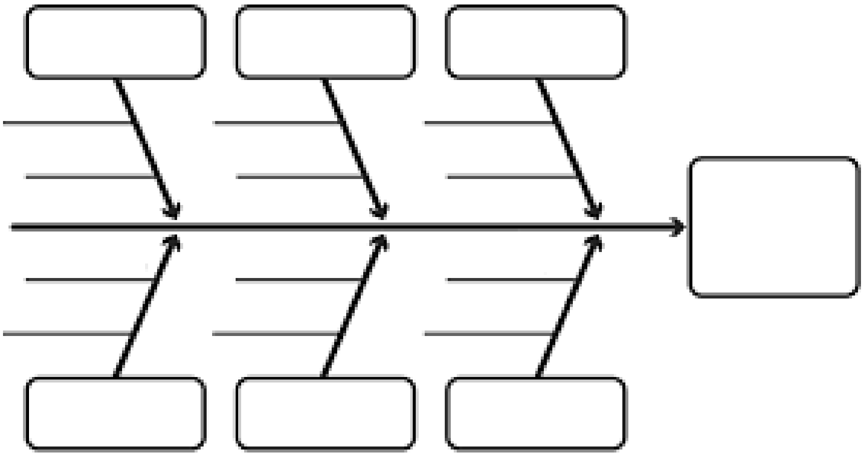
When you are working on a modelling problem/project it may be helpful to write your ideas/notes in a structured way to better shape your approach to solving the problem. Cornell note-taking can be helpful to record your ideas, think about the applications of what you're learning, ask yourself questions about how these ideas may help in your solving of a problem and how they connect with other ideas. The summary is very important as it helps you think about all of your learning and ideas and form your own ideas/conclusions.

Cues/Questions	Notes
Main ideas	*Main class notes and ideas here*
Questions that connect ideas	*Use short sentences*
Study prompts	*Use symbols and abbreviations*
Diagrams	*Use lists*
Ideas that you need to learn more about	
***When?** After class (after the notes section)*	***When?** During class time.*

Summary
What did you learn? What conclusions can you now make? Why is the information important?
How can the information be applied?
***When?** End of class or after class*

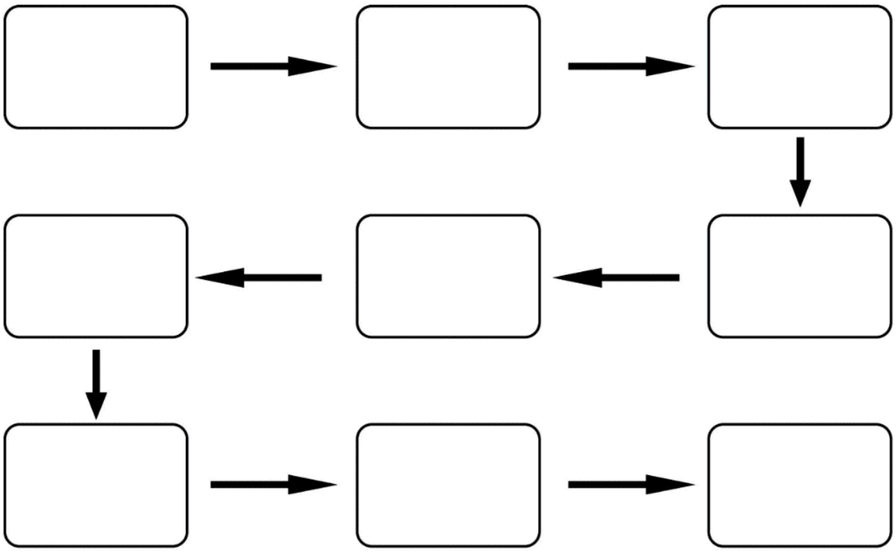
Graphic Organisers

Graphic Organisers can be a helpful way to organise and summarise your ideas when formulating a modelling problem. They can create connections between topics and be a helpful way to plan how a problem may be solved. Below is a sample of some helpful graphic organisers.



Fish Bone

A whole topic may be planned for or summarised in one space. It can organise ideas and structure information in a more helpful way.

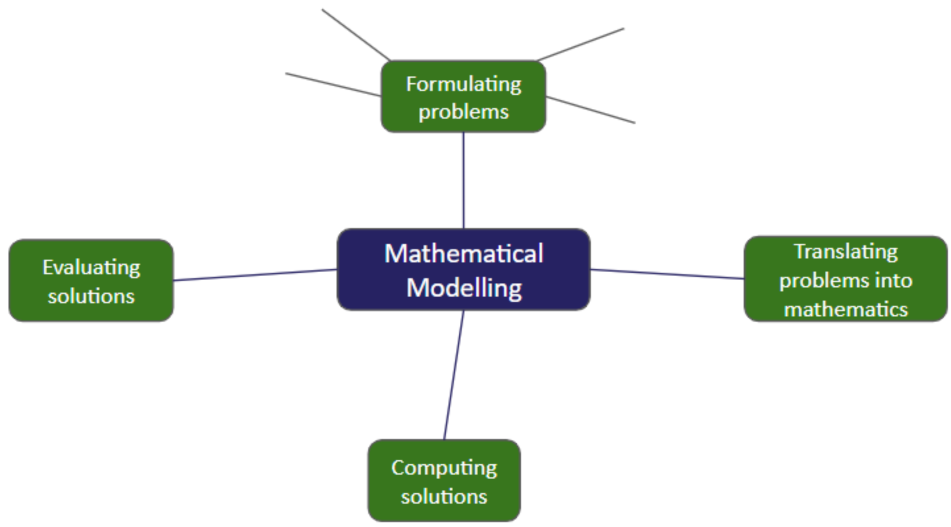


Sequence Chart

A helpful method for planning a sequence of events and the order and time that you would like to complete them.

Mindmap

A mindmap can be a useful way to brainstorm and plan a modelling problem. It is also very good for making connections.



KWHL Chart

At the beginning of a modelling problem it may be helpful to identify what you currently know and how you might learn more about a certain concept (research).

What do I Know?	What do I Want to know?	How will I find out?	What have I Learned?

Four Corner Organiser

This can be a powerful exercise for students to organise their thoughts/plans for each stage of the modelling cycle.