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| Mathematical Modelling |

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| Curriculum | **Mathematics (outside of Syllabus)** | Teacher | **BH** |
| Stage | **4, 5** | Year Group | **8 - 10** |
| Unit Length | **20 lessons over the term** | Delivery Weeks |  |
| Term | **4 & 1** | Year | **2017 - 2018** |

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| Essential Question |
| How is mathematics used to solve real, complex problems? How do you move between the real world and the mathematical world? |
| Description of Unit |
| This unit is designed to support extension students entering in the IM2C competition (more info at <https://www.immchallenge.org.au)>. IM2C, or IMMC stands for International Mathematical Modelling Competition. |
| Demonstrations and evidence of Learning |
| Culminating task: Entering in the IM2C and submitting a mathematical model and report |
| Formative assessment: Scaffolded modelling tasks with reports, building to the level required for the competition |
| Introductory task (prior knowledge): Prerequisite knowledge of algebra, functions and some Python coding useful |

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| Resources:  <https://www.immchallenge.org.au>  ICT: Python, Microsoft Excel, Canvas course |

**Overview**

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| **Learning Intention**   * To understand how to build and analyse a mathematical model to solve a problem   **Success Criteria**  I can:   * Define the mathematical modelling process * Describe a problem in mathematical terms * Create a mathematical model and Interpret the results * Evaluate the validity of mathematical model | **Key Skills**  Mathematical / Problem solving   * Abstracting the key information from a problem and translating this into a mathematical framework. Includes identifying variables, assumptions and other information required. * Following the modelling cycle * Evaluating the reasonableness of results   Python   * Carefully comment to ensure readability of code * Define functions * Use basic operations such as if, else, for * Use loops and functions to test models * Read data and write data to help test a model   Word   * Using equation builder and Latex shortcuts to help write mathematical formula * Use referencing features in Word to properly reference source material |

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| **Introduction to Modelling** | | |
| **Skills** | **Activities** | Adjustments / Notes |
|  | 1. **What is Mathematical Modelling?** 2. **Model Vignette 1: The Height Model**   This first modelling experience should be heavily scaffolded for students, and used to expose them to the modelling process.  The Problem: *Can we predict the future (adult) height of a child given the heights of their parents? (And possibly other information)*  We have already described the real world problem, but have students   1. **The Modelling Cycle**   Have students take note of the modelling cycle below.   |  | | --- | | **The Modelling Cycle** (taken from <https://www.immchallenge.org.au/supporting-resources/mathematical-modelling-framework)>  In order to be useful and applicable in practice (both in the context of the IM2C, and more broadly), the cyclic process of modelling is scaffolded (guided) by a systematic approach to individual problems, consistent with the approach taken by professional modellers when devising solutions to problems in their field.   1. **Describe**the real-world problem. Identify and understand the practical aspects of the situation. 2. **Specify**the mathematical problem. Frame the real-world scenario as an appropriate, related mathematical question(s). 3. **Formulate**the mathematical model. Make simplifying assumptions, choose variables, estimate magnitudes of inputs, justify decisions made. 4. **Solve**the mathematics. 5. **Interpret**the solution. Consider mathematical results in terms of their real-world meanings. 6. **Evaluate**the model. Make a judgment as to the adequacy of the solution to the original question(s). Modify the model as necessary and repeat the cycle until an adequate solution has been found. 7. **Report**the solution. Communicate clearly and fully your suggestions to address the real-world problem.   The interpretation and evaluation stages indicate the cyclic nature of mathematical modelling.  If the proposed first solution is not an adequate solution to the original question, the problem needs to be readdressed by repeating of earlier stages (stages 3 to 6) in sequence, and this may need to be carried out several times before an adequate solution is found.  Sometimes an extension or refinement of the original problem is suggested by the outcome of a first modelling endeavour. In this instance the question is re-specified, and further cycles of activity are conducted with the new question.  It is also important to note that although the stages are sequential, the cycle is not necessarily smooth, as the constant checking, testing and evaluating contained in each stage means that there is frequent movement within (and between) the stages – potentially making the development of some models a very challenging exercise |   Referring back to the process of working with the height model, have students identify how closely they followed the modelling process in developing the Height Model, and what components they may have not done (for example the report component). |  |

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| **Culminating Task: Modelling Report** | |
| Outcomes | - |
| Type of Task | Report |
| Weight (if applic) | - |
| Notification Date |  |
| Assessment Date |  |
| Description |  |
| Criteria for highest level of achievement | * Comprehensive knowledge of terminology * Appropriate use of technology for efficient methods * Accuracy of answers |

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| **Unit Evaluation:** |
| **What worked?** |
| **What didn’t work?** |
| **What would you recommend for next time?** |