1 August 2017

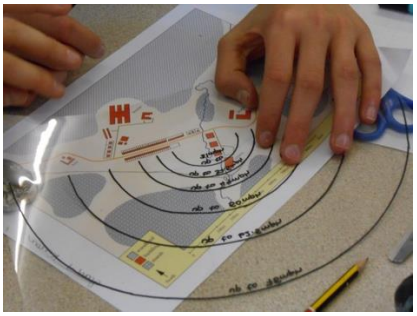
re(Solve) MATHS BY INQUIRY

SPECIAL TOPIC 7

Mathematical Modelling

Overview

These 6 units will introduce students to the process of mathematical modelling. They will provide students with skills and experience to use the mathematics that they already know to solve problems that they will meet in the real world, at home, at work or as informed citizens. The lessons will be written to assist teachers who are new to the teaching of modelling.



Australian Curriculum: Mathematics

This topic addresses the proficiencies of mathematics, in particular problem solving. There are opportunities for STEM and other cross-curriculum links.

Core development team

Prof Geoff Wake, Prof Hugh Burkhardt, Ms Rita Crust, Dr Daniel Pead (Shell Centre team, Nottingham)

Year level

The units are designed for Years 9 and/or 10. They might all be taught over these two years. The problems will mostly be able to be solved well by drawing on mathematical knowledge from earlier year levels, so that students can focus on the process of modelling.

Trialling Requirements

We are asking teachers to choose at least one unit to trial with their class. Unit content and availability is up to date at writing but may change to a small extent.

Program time required

Each unit will take approximately 5 lessons, with optional extension material. The units are designed to be taught in order but this is not essential after Unit 1. Trialling Units 2, 3, 4, 5 or 6 with students who have not done Unit 1 will require an extra introductory lesson (supplied as a separate Overview of Modelling).

Materials can be accessed from the Members section of the reSolve website http://www.resolve.edu.au. Email mbi@science.org.au to trial.

Feedback to help us improve the lessons can be provided by:

- Completing the short online survey (a link is provided on the lesson plans) AND
- Completing the Detailed Feedback questions provided for each lesson, and emailing to us AND/OR
- Making comments on the lesson plan or on student work, then scanning and emailing to us OR
- Phoning us if preferred to give your detailed responses verbally.

Some of our best feedback is obtained when another teacher observes the lesson. If you are able, have a colleague observe and provide additional feedback, or if you wish, contact us and we may be able to arrange for an external observer.

For more information about Special Topics, contact Director of Special Topics Kaye.Stacey@science.org.au or Lucy.Bates@science.org.au.To find out more about reSolve Mathematics by Inquiry, visit http://resolve.edu.au or contact mbi@science.org.au.

Mathematics by Inquiry is an initiative of, and funded by, the Australian Government Department of Education and Training

Australian Academy of Science

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Term 3 2017 (available approximately 14th August 2017)				
Unit	Year	Summary	Prior Learning/ Special Equipment	Program Time
Unit 1. Introduction to Modelling	9/10	This unit introduces students to mathematical modelling and the key processes involved. Through engaging with the modelling of two familiar queuing situations – traffic jams and waiting in line at a theme park – students develop an overview of modelling at a meta-cognitive level. Students assume a role that involves offering advice, first to police, then to theme park managers. The product is an individual report to the theme park on various aspects of queue management.	Number up to Year 8 and some algebraic thinking.	5x45min approx.
Unit 2. Pricing for Profit	9/10	Students approach the problem of how to price a product to maximise profit, in this case, items sold at a school fair to raise money. This unit will involve students in iterative cycles of model improvement as they consider more sophisticated versions. As they work through the unit students will see how varying the assumptions that they make affects the mathematical model they develop. Additionally a lesson is devoted to developing knowledge and skills in model formulation. Students will produce a report to explain how they have developed the model, and how the model can be used to develop several viable alternative pricing strategies.	Solving problems using numbers, money, ratios, percentages, equations and graphs. Connecting algebraic and graphical representations. Spreadsheets will be used.	200-240 min approx.
Unit 3. Packaging Design	9/10	Students assume the role of consultants to a packaging company that produces packs for a range of different cylindrical objects such as candles, drinks bottles, and perfumes. Comparison is made between the design cycle and the modelling cycle, and students reflect upon how design work might be informed by an understanding of mathematical modelling processes. As an additional task, students are given some practice scenarios so they can develop their skills in interpreting and critiquing mathematical models.	Understanding of three-dimensional objects and their representation in two dimensions. Measuring and construction, and geometrical facts. Paper or card, scissors, glue/tape.	200-240 min approx.

Term 4 2017 (available approximately 14th September 2017)				
Unit	Year	Summary	Prior Learning/ Special Equipment	
Unit 4. Vehicle Turning	9/10	Students consider how roads and car parks could be designed to ensure that vehicles have sufficient space to safely make a sharp turn, i.e. without mounting the kerb, or having the ends of the vehicle swing into another lane while cornering. This more complex context benefits from dynamic geometry simulations and physical models to help decide what vehicle characteristics most affect turning. Students produce advice for a construction company building a supermarket carpark. They discuss how best to achieve effective communication of modelling in a relatively complex context.	Measuring and construction, and geometrical facts (e.g. Pythagoras' Theorem) Dynamic geometry software. Model/toy cars	200-240 min approx.
Unit 5. How Safe is Life?	9/10	This 'descriptive modelling' unit introduces concepts of statistical modelling, with a focus on the interpretation of data and evaluation of the inferences drawn from it. Throughout the unit the goal is to develop students' ability to work and think independently, and to develop an informed scepticism about dramatic claims on risk. Students consider risk in everyday life and investigate the relative probability of various causes of death - unnatural and natural - including terrorism, disease and accidents of various kinds. They consider how factors such as age affect the data, and discuss the usefulness of the model to predict a particular person's future.	Proportional reasoning. Basic probability concepts.	200-240 min approx.
Unit 6. Broadening Modelling Experience	9/10	This unit will give students experience in tackling both short and longer modelling problems more independently, and reflecting on the aspects of modelling in each. The contexts will include opportunities for exponential models (such as growth of feral animal populations) and for proportional models. Students will gain insight into the limitations of their growth models, and will collaborate to improve their accuracy.	Experience with simple and inverse proportion models, and with exponential growth.	200-240 min approx.