MODELLING MOTION

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Short description of the Workshop Groups: organizers, aims and underlying ideas

This workshop builds on the results of a research project, Modelling Motion: Developing Mathematics Concepts through STEM activities, which was funded by the Australian Association of Mathematics Teachers and the Australian Academy of Science. The activities were developed from the work of Galileo Galilei (1564-1642) who challenged the scientific wisdom of the Age that had been established by Aristotle.
In this workshop, attendees will perform activities, using the materials now available on the world-wide web, with a view to establishing the rôle of such activities as a part of a STEM programme that develops students' new mathematics, and not merely employs already known mathematics as a tool.

Planned structure:
Insert the planned structure of the workshop in the table below. You can insert rows if needed.

Planned timeline	Planned activity	Working format /Responsible person
Session One	This session will begin with some background to the work of Galileo and the *reSolve Project*. Our research showed that many children have no idea of speed as a derived unit of measure. The focus is on either time or distance, but rarely on both. As many of the activities in *Modelling Motion* require measurement of speed in term of time and distance, it is necessary to investigate what speed means conceptually. To unravel what 'speed' is, the initial question poses the question 'Can you walk at a constant speed, and if so, how can we tell?' A discussion follows. Paper streamers are used to record the distances that people travel in successive equal time intervals. A streamer is laid out next to the path of the movement and participants place markers to show the position at each time interval. The streamer can then be cut into	This is an orientation to the work of Galileo and the materials developed in the resolve project. Video examples of students experimenting will be shown. This is followed by a plenary discussion. Finally, some homework reading will be set.

	sections and arranged as a column graph. The graph is then interpreted through a whole group discussion. Note that the use of streamer graphs enables the mathematics to explain the physics.	
Session Two	In this next session we will employ Galileo's 'gravity diffuser' that allows us to measure how far a ball travels during successive time intervals. This was a crucial experiment that allowed Galileo to attack the Aristotelian precepts of motion. Our activity follows that of Galileo and builds on our experiences from Session One. The mathematics, again, is fundamental to explaining the physics. Finally, we will show what happens to objects that are free-falling under gravity, and thus establish a mathematical relationship between distance fallen and time.	Again there will be a discussion about free-falling objects, which extends the ideas developed in Session On. After collecting suggestions for whatmight be observed, there will be a video showing students at work on this problem. Finally, there will be a plenary discussion. Again, some homework reading will be set.
Session Three	In this final session we will investigate what happens when a motion is the result of two forces. Unlike the previous activities, this activity involves participants in observing a slow motion and explaining how what they see comes about. While this is a simple experiment, the mathematics is not so simple for those of us without experience with a Cartesian plane.	Again, video examples of students at work on this aspect of motion. Participants will be expected to tell everyone what they think will happen before we show the student work. The discussion at the end of this activity will recapitulate the entire set of activities and also explore some of the other activities from the *Modelling Motion* research. A plenary discussion on the role of mathematics in this aspect of science will examine ideas about the place of mathematics in STEM activties.

Venue requirement:

As this is a virtual workshop, the only requirement is that participants have an Internet enabled and connected laptop with them.
The workshop can be undertaken anywhere on the Internet.

References

Drake, S. (1975). The role of music in Galileo's experiments. *Scientific American, 232* (6), 98-105.

Galilei, G. De Motu: http://echo.mpiwg-berlin.mpg.de/MPIWG:ZR79G89F
Galileo Project: http://galileo.rice.edu/sci/theories/on_motion.html

MacDougal, D. W. (2012). *Newton's Gravity: An Introductory Guide to the Mechanics of the Universe, Undergraduate Lecture Notes in Physics.* ISBN 978-1-4614-5443-4. New York: Springer Science+Business Media.