

Review

Nuffield STEM Futures: An 11-14 cross-curricular topic

Title:	Nuffield STEM Futures: An 11-14 cross-curricular topic
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SCOM compatible discs are available free on request from Nuffield



It's an uncertain time for advocates of STEM (Science, Technology, Engineering and Mathematics) as a construct for thinking about the curriculum – at least it is in the UK. We have a coalition Government whose education policies seem firmly focused on 'subjects' rather than anything that smacks of cross-curricularity (Gove, 2008). As a result, England's STEM Advisory Forum, a web forum used by a wide range of leaders in the STEM community to discuss STEM issues broadly and influence policy has just (April 2011) been closed down with elements of its forums due to transfer to the National STEM Centre in York.

D&T, in any case, has had an interestingly nuanced relationship with STEM as the focus for thinking about the curriculum; partly because of concerns that the 'D' in D&T is not properly recognised and partly, particularly in the early days of the English STEM programme, through a concern that the real focus was on Science and Maths. Throughout the time that the STEM programme has been running there have also been various degrees of uncertainty about whether the focus should be on increasing participation in the individual subjects or on developing links between them. Those wishing to pursue the latter route have generally not had a lot of external support they could draw on, so the decision by the Nuffield Foundation to build on its considerable experience in Maths, Science and D&T curriculum development to develop a KS3 (11-14 years) STEM project was very welcome. (Since Engineering is not included in UK curricula at this age, the subjects that this STEM project builds on are Science, D&T and Maths.)

The final materials from the project are published as a set of (free) web materials (Nuffield, 2010), including PDFs, Flash animations, Word files of resources and PowerPoint files for each activity along with a range of very high quality video resources. A SCORM (Sharable Content Object Reference Model) compliant version, which should work with any

modern virtual learning environment (VLE), is also available. There are also pointers from each unit to the Nuffield materials on Applying Mathematical Processes – so that effective use can be made of the Foundation's existing materials to support this cross-curricular work.

The underlying theme of the materials is sustainability; this is undeniably topical and important as a context and encompasses a range of content that cannot be constrained within the bounds of a single subject; many schools see sustainability as a thread that should run right through all subjects – STEM subjects are not alone, by any means, in having an interest. STEM is, however, quite a logical cross-curricular grouping for sustainability work since many of the key issues that arise rest on scientific understanding of natural and material processes, along with mathematical understanding, and solving the legion of problems required for sustainability requires combining this understanding with the skills of practical problem solving that are the domain of D&T.

The materials comprise five pupils units (called 'Pods') along with supporting teaching notes, clear background notes and support for a series of CPD sessions to ensure a unified approach to the materials from teachers from different subject traditions.

The teaching sequence for the pods is shown in Figure 1 (taken from the Teachers' Guide) along with the approximate time required for each pod. This model is designed to be flexible, with the number of pods used in a teaching sequence being dependent on the time available. The intent of the authors is that any teaching model should include the introductory pod (1), at least one of the enabling pods (2-4) and the project pod (5). The resources for each pod include an overview, teachers' notes, pupils' tasks, videos and animations and a presentation.

Review

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Pod 1 introduces some key ideas about sustainable human and natural uses of materials. In particular the notion that it is not waste per se that is the problem in developing new products sustainably, but rubbish; the difference being that rubbish is waste that is not useful. So if all waste from human processes could be used, either in other human systems or by nature, there would be no rubbish. This set of ideas has come to be known, in D&T circles, as 'cradle to cradle design' (Braungart & McDonough, 2009) but here is generally referred to as a closed loop system. Those of us working in electronics and systems & control in D&T will be conscious that these subjects employ a different use for the phrase 'closed-loop' to mean a system that includes feedback – and this difference may need to be made explicit to pupils. However the use of systems thinking to underpin children's understanding of sustainability seems to me to be a very powerful tool that can not only support learning in both Science and D&T very well but can also act a vehicle for carrying understanding between the subjects – something that anyone who has tried cross-curricular work will know is one of the hardest things to make work well.

Most of the material in this pod could be taught in either Maths, D&T or Science lessons, though some of the equipment required in the third lesson is more 'sciency' in nature (tripods, Bunsen burners etc.).

The enabling pods (2-4) build on the Introduction but are independent of each other; pupils can follow these in any order and do just one, or more if time is available.

Pod 2 examines the topic of waste and its relationship to rubbish and introduces the concept of 'precycling' (design for dismantling and easy recycling).

Across the pod there is a good mix of content from science (including natural cycles such as the carbon cycle), maths (graph interpreting and creating) and D&T (sustainable product design). No specialist equipment is required and the nature of the support materials means that this topic could be taught in any of the three subject bases (or, of course, shared between them).

This pod uses a slightly curious turn of phrase (to D&T ears at least) in contrasting natural materials with 'technical' materials – where technical here means simply synthetic, human made, rather than hi-tech or 'smart'.

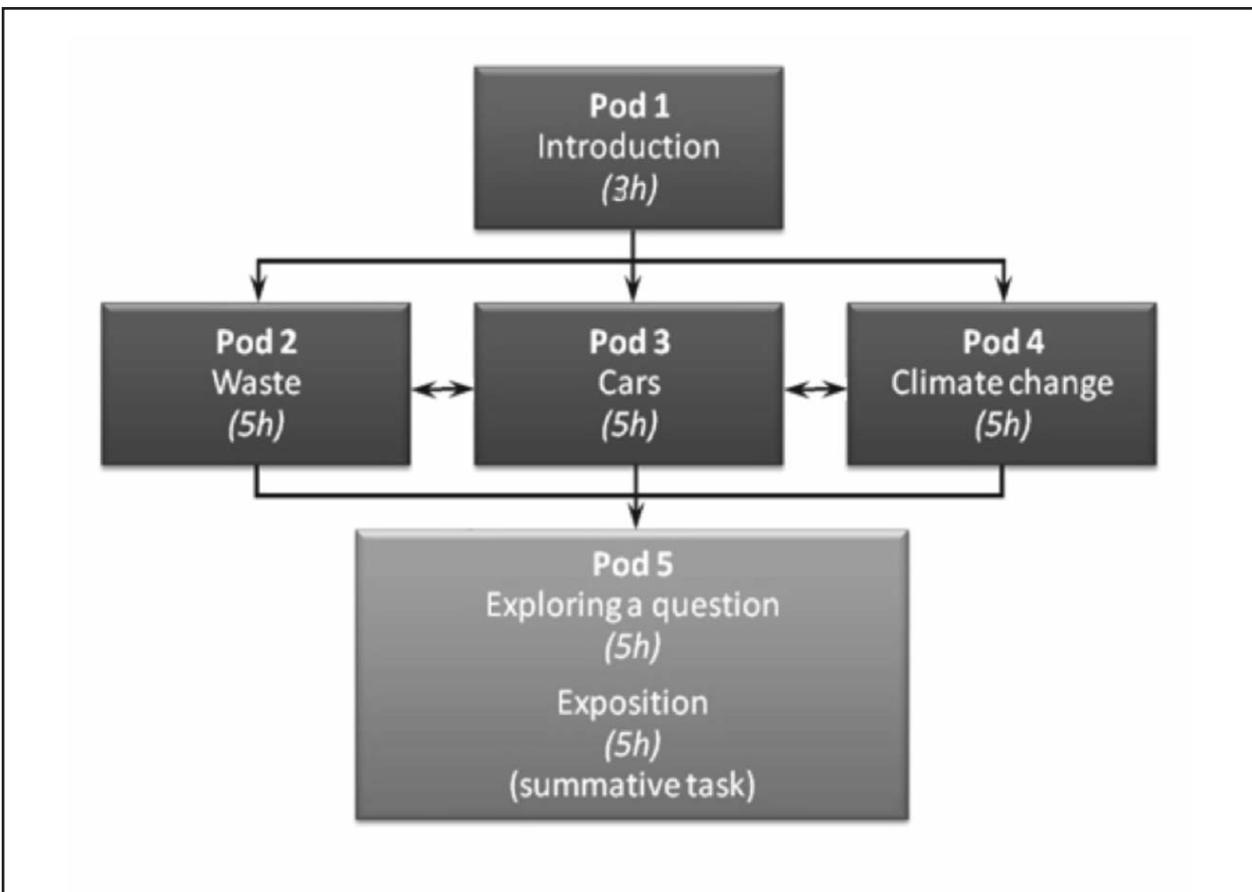


Figure 1

Review

Nuffield STEM Futures: An 11-14 cross-curricular topic

This serves to underline what a complex task it is to write materials to be used across material areas where not only terminology but also procedures for common tasks can differ considerably; the answer is, I think, not to try to always align terminology and procedures but to be clear with both teachers and pupils that these differences exist and to note them where they occur.

Pod 3's focus on cars and transport provides, amongst other things, the opportunity to plan and carry out a scientific investigation (on pollution), to apply mathematics in the development of a solution to a pollution problem and to design a sustainable school transport plan. Like pod 2, this topic could be taught in any, or a combination of, the three subject bases

In Pod 4 the focus turns to the broader subject of climate change. Again the subject matter selected supports learning in all three relevant subjects, including work on the carbon cycle, the relationship between atmospheric CO₂ and climate change, modelling of carbon footprints using a spreadsheet and designing an exhibit to support a wind farm installation. The second lesson makes use of equipment generally found in a science lab for a demonstration of the greenhouse effect caused by CO₂. However this is not a messy demonstration and science technicians could set this up in any classroom or workshop.

The fifth pod uses the work done in previous pods to support a pupil project. This is where the 'Futures' theme of the materials comes into focus as the theme of the project is intended to be directed at an environmental problem and make use of closed loop thinking along with the other knowledge and skills built up during the prior work. In the spirit of a STEM project, the work of pupils is broader than a D&T design and make project but will generally draw on D&T designing and making skills along with the scientific understanding and mathematical problem solving skills that have been developed.

Alongside all the materials to support the teaching of the pods, there is a set of 10 CPD modules designed to ensure that the teachers supporting this cross-curricular work (who will, presumably, be drawn from the three STEM subjects) are working in a unified, coherent way. The units range from analysis of subject knowledge through pedagogical and planning matters to discussion of some of the big ideas in the unit – in particular closed-loop thinking and sustainability. The fourth and fifth CPD units focus on running the pods and, in particular, the project pod (5) including the ways that the project could be organised using larger blocks of time than lessons.

One thing that the CPD units don't discuss explicitly (possibly because of the complexity of the subject matter) is the broad but delicate matter of departmental interaction. This will include such things as what the relationship between the participating subjects is (when does one subject serve another and when does it lead the work), how teachers from the three contributory subjects can be encouraged to work together on a topic like this, how they might share the work between them, how subject expertise is best deployed (or shared) so that subject specific materials are taught to the highest possible standards (and support rather than undermine other subject teaching), how the various costs (time, materials...) are shared and so forth. Anyone who has engaged in cross-curricular work of the kind promoted by the Futures materials will know that its success can be highly dependent on getting this kind of groundwork right; it would be a useful addition to have some guidance on these matters (or pointers to guidance elsewhere?).

References

Braungart M, McDonough W (2009) *Cradle to Cradle*; Re-making the way we make things Vintage Books

Gove M (2008) *We will reverse Labour's devaluation of exams* Speech, November 2008 available at http://www.conservatives.com/News/Speeches/2008/11/Michael_Gove_We_will_reverse_Labours_devaluation_of_exams.aspx Retrieved April 2011

Nuffield (2010) Nuffield STEM Futures available at <http://www.nuffieldfoundation.org/nuffield-stem-futures> Retrieved April 2011