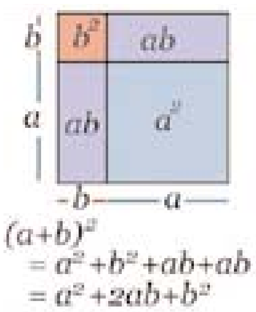
Diversity in the National Curriculum—Mathematics

Diversity in the mathematics classroom

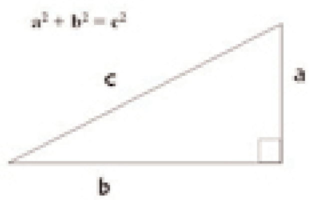


On numerous occasions, over the past ten years or so, I have been told by people otherwise proud of their education, that they:
1. don't like (or even hate) maths;
2. are no good at maths;
3. value other things like literature or geography but *maths*—that's for the nerds and geeks.

What an extraordinary situation! In contrast to virtually every other subject of human enquiry, mathematics appears to have acquired the modern status of being regarded, at best, as a necessary evil. 'I'm hopeless at maths' you will hear people cheerfully admit. No one boasts of being illiterate; why should they feel happy at admitting to being innumerate?

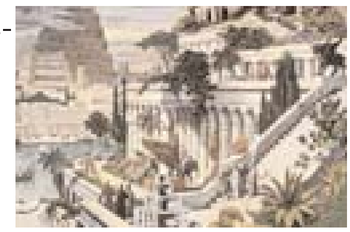
Why has mathematics become the 'necessary evil' of our educational system? And how do we Maths teachers, people who actually love the subject, try to demonstrate to the children (**and** their parents) the sheer beauty of the subject, along with the diverse and fascinating histories that lie behind every mathematical concept?

There is much more to mathematics than dry formulae on the blackboard—and even these can sometimes elicit extraordinary and exciting stories of the people who first discovered them in one way or another.



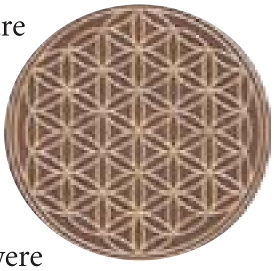
Take Pythagoras' Theorem. It is not only that the sum of squares on two smaller sides of a right-angled triangle always add up to a square on the longest side that would excite those who are being initiated into the art of mathematics. Add to the mix the facts that are linked to the discovery, propagation, misinformation, and the uses of the theorem itself and the story becomes fascinating. First, it is named after this mysterious figure, Pythagoras, who organised one of the earliest secret and scientific societies—and all for the purpose of studying mathematics, and thereby, the world. Second, the theorem was not even invented by Pythagoras—it may have been formulated by him, but was used centuries before by the Babylonians (the people who gave us the sexagesimal system—base 60—still used in time measurement). Third, Pythagoras himself may never have existed; all we know about him comes from historians who lived centuries after Pythagoras apparently perished. Fourth, the knowledge of his theorem was in the mediaeval times considered a secret by the stone-masons who travelled around Europe to build cathedrals of unimaginable beauty. Fifth, the Chinese knew about the theorem around 1100 BC and proved it around 100 BC totally (presumably) independent from their European counterparts. And so on—I could go on *ad infinitum*.

If someone tried to teach literature only by making children learn the grammar, or art by teaching them all the different ways you can mix pigments to get tempera colours, results would probably be similar to what we get today regarding the perception of mathematics. For the past few centuries (and this is no fault of ours) people have taught mathematics in this way—trying to make children learn only how to work things out. The history of that process—of dulling mathematics from the high regard in which it was once held because of its ability to be used a tool of understanding and developing the mind, to the place in which it is sometimes held now—is in itself fascinating, but about that on another occasion. What I'd like to discuss here is how to find that— as it were—*secret*

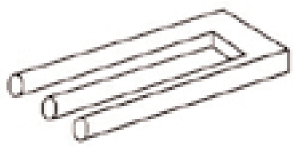


garden of motivation in which mathematics grows on every tree as a different type of fruit—an apple, pear, banana, an occasional mango. And there are bushes there, too, with all kinds of berries!

Mathematics has a rich and exciting history and, as in any other discipline, there are masters to learn from. There are the histories to be learned about the groups of people who developed mathematical concepts because of their particular interests, such as architects or artists, or those who were simply fascinated by the mathematical principles to such an extent that they met after work and discussed mathematics for an hour, then worked for an hour in quiet—like the weavers of Spitalfields did in eighteenth-century East London.



I am not a great proponent of teaching mathematics entirely in this way, nor of teaching only mathematics that is related to the real world, or as some call it 'useful'. After all, some of the beauty of mathematics lies in its utter uselessness, and what can be regarded by some as a utterly useless piece of mathematics, can later be proved to be very useful indeed. A recent study at the Ohio State University Center for Cognitive Science also showed that students who learn mathematics only through 'real-life' problems fare much worse than those who learn abstract mathematics. An article on this can be seen at the *Plus Magazine* site (http://plus.maths.org/latestnews/may-aug08/concrete/index.html).



However, the history of mathematics not only brings different cultures, histories, and individuals into a classroom through the work of a good teacher, but helps students make synoptic networks of understanding and can ignite a 'learning fantasy'—something that we have all experienced at one time or another—a need to go deeper and deeper into a thing, to learn all about it, and to see it from all angles. The pursuit of mathematics depends on these.

So for those teachers who would like to try the history of mathematics, here are some guidelines for developing resources and techniques to bring the history of mathematics with all its diverse connections and concepts into the classroom.

Yr 7 students learn about surveying techniques in mediaeval times

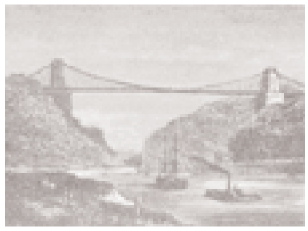
First, be aware that there is no prescribed way of making resources in the history of mathematics or of doing research in the subject. In the classroom however, the weakest links become immediately apparent when a clever kid asks you one of the five 'W' questions. It is therefore good to cover these first, so that you yourself know exactly the 'What? When? Where? By whom? and Why?' of the concept/topic you have chosen to research and consequently teach.

The five 'W' points of reference for developing the teaching around a topic can be summarised as follows:

What is the topic in its entirety? Begin from the whole picture and break it down into simpler bits. Making mind-maps can be useful at this stage.

When did this concept first appear in mathematics?

- Was it known beforehand? or
- Was it applied by 'professions' such as engineering and architecture or even art?
- How did it develop throughout history?



For example, Pythagoras' theorem was used by the Babylonians and Egyptians but it was the Greeks who first made an abstract generalisation of the facts related to it. Making a time-line is helpful at this stage.

Where? Was this concept developed in one place only or in one region and what would be the possible answers as to why this happened?

For example the prime numbers have interested huge numbers of people and reappear as a topic of interest in many cultures. Knowing something of these different cultures, listing and learning about the places where people who were interested in the prime numbers lived/worked enlivens the introduction and the discussion about the mathematical research itself, and makes it easier for the children to map the development of a concept not only chronologically but also in terms of geographical expanse.

Making a map of discoveries and listing the places may be very useful.

By **whom?** Who were the crucial mathematicians/ engineers/scientists/philosophers/artists who were involved in the development of this topic? What different things did it mean to them?

Find out about the different people who developed the topic at hand. Introducing role models in the teaching of mathematics may bring many benefits. Using posters on mathematicians involved with the topic is one way of tackling this part of the research.

Why? (how?) is probably the most important and the most difficult question. Why? might be asked in two ways:

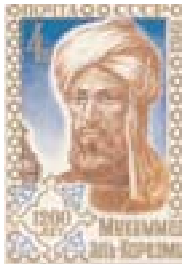
- why was the concept developed?
- why do we need to know this?

After these are considered, other questions may spring to mind in this context:

- why did the people become interested in this topic?
- why did a particular person come to (some) conclusion? etc.
- why was it done in this way and not in another? (Or was it done in another way too?)…

There are some websites that can help you with this process (one of them being mine—www.mathsisgoodforyou.com). But you could also try doing research through places like *Plus Magazine* (http://plus.maths.org/) or the *Nrich* website (http://nrich.maths.org/public/) both of which have numerous pages on historical topics. *Plus* + will provide resources for story-telling that you can develop for ordinary lessons or master classes; *Nrich* will give you stories and tasks to complete. The *Maths is good for you* website has both—you can do the research but you can also download worksheets, master-class booklets or power point presentations for your lessons. The children can help too. Try using history of maths 'webquests' like http://192.107.108.56/portfolios/p/pizzuto_b/webquest/index.html or http://coe.west.asu.edu/students/msyrkel/webquest calculus.htm which are self-contained small websites that have set tasks for children to complete but that can then be expanded upon in the classroom.

Finally, my suggestion is to make the best use of past mathematicians and bring them to life and into your maths lesson – surprisingly, they can be extremely helpful as classroom assistants!



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Additional Resources

The **Real Histories Directory** has a number of resources that might be of help to teachers wishing to introduce more diversity to their teaching of Mathematics.

Global Dimension (www.globaldimension.org.uk/resourcesearch/results.aspx?selSubject=32&rs=cs) list a number of resources suitable for the teaching of mathematics including Christian Aid's *The Poverty Challenge*, Oxfam's *Bring on the World* and *Water Splash*.

Global and Anti-Racist Perspectives within the Primary Curriculum (www.garp.org.uk/) is an extensive resource, developed by teachers in Nottingham. The folder shows in great detail how a global perspective can be included within each subject of the primary curriculum. There are sections for every subject, beginning with an introductory overview of links to global perspectives. This is followed by a detailed framework showing resources and ideas for each QCA unit of work within the England National Curriculum.

With ***Human Rights in the Curriculum: Mathematics***, (www.amnesty.org.uk/books_details.asp?BookID=10) produced by Amnesty International and the Education in Human Rights Network, secondary school teachers can teach Mathematics and Citizenship at the same time. The book addresses all the human rights challenges of Citizenship education withing the context of the secondary mathematics classroom. Its 30 thought-provoking, entertaining and multicuiltural activities have been developed by teachers and fully trialled in a range of schools.

Great Hindu Pioneers of Science (www.hinducounciluk.org/newsite/circulardet.asp?rec=44) includes, for example, the 4th-century astronomer and mathematician Aryabhatt, and the 12th-century algebra genius Bhaskaracharya II.

The **Respect for All: Subject case studies** site (www.qca.org.uk/qca_6867.aspx) covers all subjects in the national curriculum and has real examples of good practice from schools across the country, showing how teachers are valuing diversity and challenging racism. **Respect for All** (www.qca.org.uk/qca_9580.aspx) also has an article on Mathematics and its potential for valuing diversity and challenging racism.

Multiverse has an ITE session on anti-racist mathematics (www.multiverse.ac.uk/attachments/d2a10fae-efd8-48bb-bc30-65e14d08782c.doc) and an ITE teacher educator session on teaching about diversity through mathematics (www.multiverse.ac.uk/attachments/99d81c79-21fc-48de-80d0-697817cc0348.doc), specifically the contribution to our mathematical heritage by a variety of civilizations. Further resources include information sheets on Babylonian numerals (www.multiverse.ac.uk/attachments/9133ebd6-6b40-4ead-90ff-e36e8224376e.doc), Hindu-Arabic numerals (www.multiverse.ac.uk/attachments/bf4abc2a-9308-4ca0-afe6-f4c9c7c4f06e.doc), Inca numbers (www.multiverse.ac.uk/attachments/189dea26-570c-4f0c-adaa-a80ee001d038.doc), Mayan numbers (www.multiverse.ac.uk/attachments/1e3a8c2e-6d2a-49a7-ab90-b65655707e54.doc), Roman numerals (www.multiverse.ac.uk/attachments/7401928e-e1dc-4f96-bbf0-8844bc2d0ac9.doc) and Arabic hundred square activity.(www.multiverse.ac.uk/attachments/b7fb32bf-81f0-4a7a-b377-f7f62ae901ef.doc). The site also offers website resources for mathematics and science in community languages (www.multiverse.ac.uk/ViewArticle2.aspx?ContentId=13013)

Finally, for KS 2 and KS3 students, the **Birmingham Grid for Learning** site has the **Booster Sea Mission** (www.bgfl.org/bgfl/custom/resources_ftp/client_ftp/ks2/maths/booster_sea_cl/index.htm), a fun series of eleven activities to help with maths in English, Urdu, Arabic, Bengali, Chinese and Somali.

The Real Histories Directory

The **Real Histories Directory** (www.realhistories.org.uk) has been created as a resource tool for teachers, parents, pupils and the wider community to support them in their teaching and learning about cultural diversity in the UK. The website helps you to locate **resources** in your and other LEAs, such as storytellers, dual language books, culturally diverse toys and relevant **events** taking place in the UK. There are also items of **news** that may be of particular interest to schools and teachers.

You can also submit resources that you would like to include in the directory free of charge by visiting the site, clicking on 'Submit an entry' and following the on-screen instructions.

As well as the varied resources available, each month a new **Topic of the Month** is added with suggestions for using the Directory in the classroom and at home.

We are interested in hearing your views on our Topics and the Real Histories website. You can email comments and suggestions to: realhistories@runnymedetrust.org.