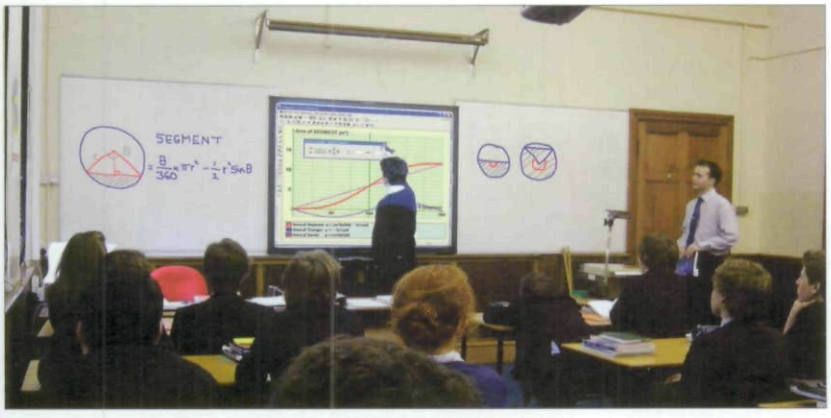
HAVING FUN WITH *GOOGLE EARTH*

Douglas Butler believes that teaching with dynamic images (from software and the web) makes mathematics lessons more effective, more efficient and a lot more fun.



There are many mathematics teachers now who, when entering a classroom without a data projector and internet connection, feel as though they are flying on one wing – such are the amazing opportunities that these relatively new gadgets can offer. The range of dynamic software and web applets is growing rapidly, and this exciting situation is enough to make me, for one, wish I were 25 again and starting all over.

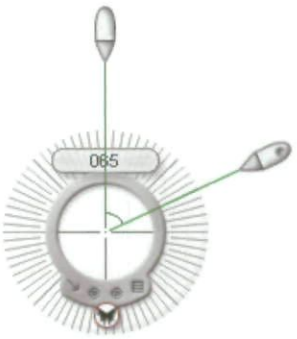
Google Earth

Google Earth (http://earth.google.com) is freely available to anyone with a reasonably fast computer and internet connection. It is an application that needs installing, but, once there, it offers the opportunity for an exciting new range of screen-based classroom activities, involving shapes you can spy on from above.

There is an alternative: *Flash Earth* (www.flashearth.com), which does not need installing. So with this you can, from a standing start, find things around the planet very quickly if you know where to look, or you can use its simple search window.

Screen Protractor

If you also download the *Screen Protractor* (www.iconico.com/protractor) from *Iconico Inc*, an innovative New York software house, you can easily measure angles of familiar objects around the world. I discovered this utility about a year ago. It was written for surveyors, but I suggested a long list of educational options (eg, radians, bearings, etc), and the author put them all in!



This protractor is easier to use than the usual D-shaped circular protractor, which does not lend itself to screen simulation so well. (To get it to work with *Google Earth*, you need first to check that *Google Earth's* 3D mode is set to 'DirectX', and not 'OpenGL'.)

The Pentagon

If you are teaching polygons, why not go to look at a real pentagon. Just load *Google Earth* and put in 'The Pentagon' and it will fly you there. For example, you can confirm that the interior angle is 108°.

You will notice that there is now a 3D representation of the building in *Google Earth*, but it is also very instructive to use the sister 3D construction program *Sketchup* (http://sketchup.google.com/) to get your students to make their own.

While you have *Google Earth* open, why not nip over to 'The Pyramids Egypt' where you can eavesdrop on some very handsome solids.

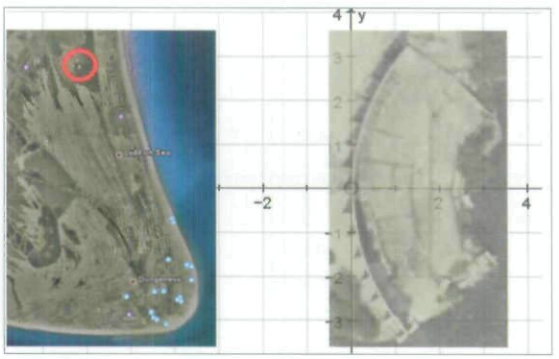
Sound mirrors

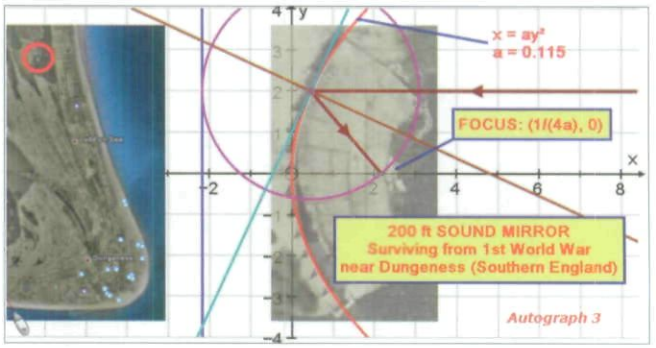
In the 1920s, some very large structures were built along the south coast of England to deal with the increasing threat of aerial attack. They were huge parabolic mirrors, and worked well (but only if the aircraft obliged and flew in line with the axis.)

Malta

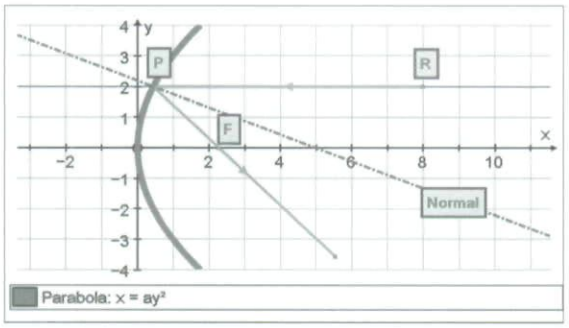
One of them survives near Dungeness, and there is another one in Malta (North West of Naxxar). Finding them using *Google Earth* or *Flash Earth* is a challenge, but very satisfying. Happy hunting.

You can enter 'sound mirrors' into *Google* to find out more about them.





Once you have them on screen, you can use the **PrtSc** button to grab a good image of the mirror, paste into Paint, crop as required, and save in jpg format. The Dungeness one is conveniently facing due East, so is easy to fit a graph to. Using *Autograph* (www.autograph-maths.com), make the image semi-transparent, enter $x = ky^2$, and use the dynamic constant controller to find the appropriate value of k to fit the mirror.



Next, use *Autograph* to explore what it is about a parabola that makes it a useful mirror. First, place a point on the parabola, and draw a horizontal line and a normal from that point. The trick is to create a 'shape' of two points on the horizontal line and reflect it in the normal.

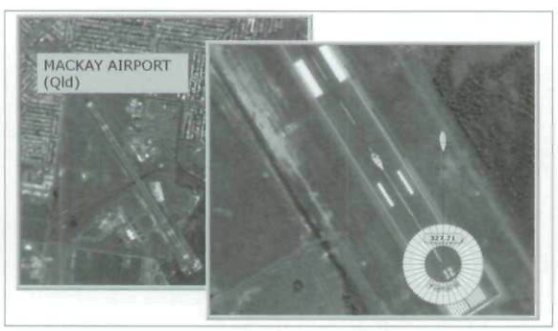
As you drag the point up and down the curve, the reflection always passes through the same point, called the 'focus'. On the actual site, the position of the receiving device has gone, so you can now tell them where to put it back.

This example can be highly motivational – a large structure copied straight off the web that has to be parabolic to work, and you can illustrate immediately why this is so. Now go hunting for the one in Malta – it's even bigger.

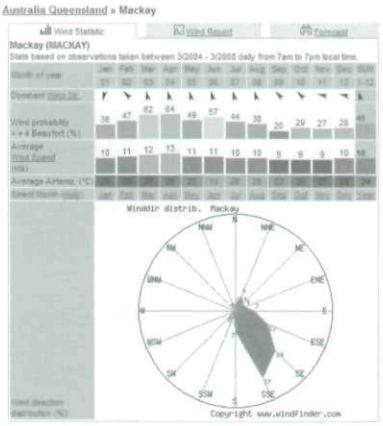
Airport runway numbers

Another lovely use of *Google Earth* is to explore the direction of airport runways, as indicated by the number painted in large letters on each end. First, see if the students can puzzle out what the number means – the on-screen protractor (set to 'Bearings') is useful here.

This number in fact gives the direction of the runway in tens of degrees from magnetic North (eg, 'Runway 20' is at 200° clockwise from North; ie, S 20°W).



Illustrated here is the airport at the coastal town of Mackay in Queensland. This got me wondering how they decide in the first place what direction to build a runway in. It must be something to do with the prevailing winds, as aircraft like to take off into the wind.



A quick search in *Google* delivered a marvellous site (www.windfinder.com/windreports/windkarte_world.htm) that gives what I can best describe as circular histograms for the wind in various locations – by month, and over the year as a whole. This site is primarily meant for wind-surfers, who are always on the lookout for a good blast of breeze, so the information is generally restricted to coastal areas round the world.

The results for Mackay airport were very satisfying. Its airport was built in an area with a prevailing SSE wind, and the runway has '32' written at one end – just about right. So what's the number on the other end? Get your students to puzzle it out before you take a look.

You could of course also look at your own local airport, or Heathrow, where the runways go East-West (so are numbered … '09' and '27'). Take a look next time you are taking off.

Conclusion

Many of these ideas can be found on the TSM resources website (www.tsm-resources.com), and many teachers will be coming along and practising all this at the 2008 TSM 3-day workshop (www.tsm-resources.com/tsm-08) at Oundle School, Peterborough, early this month.

It is not really worth comparing classrooms with and without a web-connected projector. You have got what you've got, and mathematics teachers the world over are doing magical things to inspire the young using whatever comes to hand.

All I do know is that there seems to be growing evidence that teaching with dynamic images (from software and the web) can make mathematics lessons more effective, more efficient, and certainly a lot more fun.

Douglas Butler is director of the ICT Training Centre, Oundle. debutler@argonet.co.uk
www.tsm-resources.com